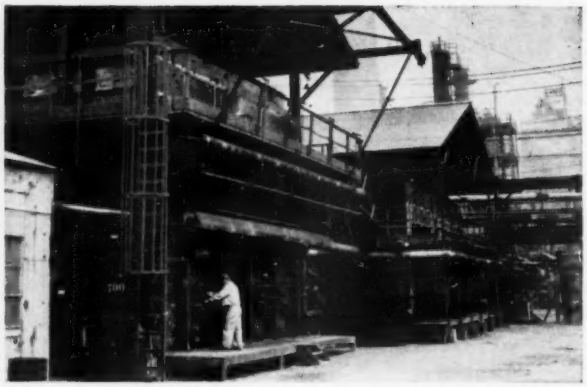
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

POWER

September
1953 50¢

A McGRAW-HILL PUBLICATION

...for coal costs... make it flow! ☞p 98



Typical plants where L&N oxygen recording equipment keeps total oxygen completely and accurately recorded, for more efficient combustion control.

Left: A steam central station (boiler furnace in rear) in an eastern utility. Right: A process heater in an eastern oil refinery.

NEW PERFORMANCE for COMBUSTION EQUIPMENT

with the L&N Magnetic Oxygen Analyzer

● Rugged, stable and precise, this unique analyzer detects the percentage of oxygen in flue gas from boiler furnaces and process heaters in oil refineries. Since oxygen is the most reliable index of excess air, especially when firing with mixed fuels, these desirable advantages are now made possible:

(1) combustion efficiency goes up (2) fuel costs go down, and (3) maintenance time is cut to the barest minimum.

To triply assure you of best results, Leeds and Northrup has teamed up this advanced instrument with the Speedomax® Recorder and a sampling unit experience-engineered for reliable operation. This efficient combination offers you this warranted and superior performance:

- **Calibrated Accuracy:** ± 0.15% oxygen against standard gas mixtures
- **Sensitivity:** Better than ± 0.05% oxygen
- **Stability:** Better than ± 0.15% oxygen
- **Speed of Response:** Initial—8 to 12 seconds; 90% of final reading—35 seconds

To revitalize your fuel-burning efficiency, remember that *L&N oxygen* equipment gives you . . . a rapid response to oxygen for *"tight" combustion control* . . . an accurate check on air with *no need for tank samples* . . . the most practical answer to *continuous, trouble-free operation.*

For further information, write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

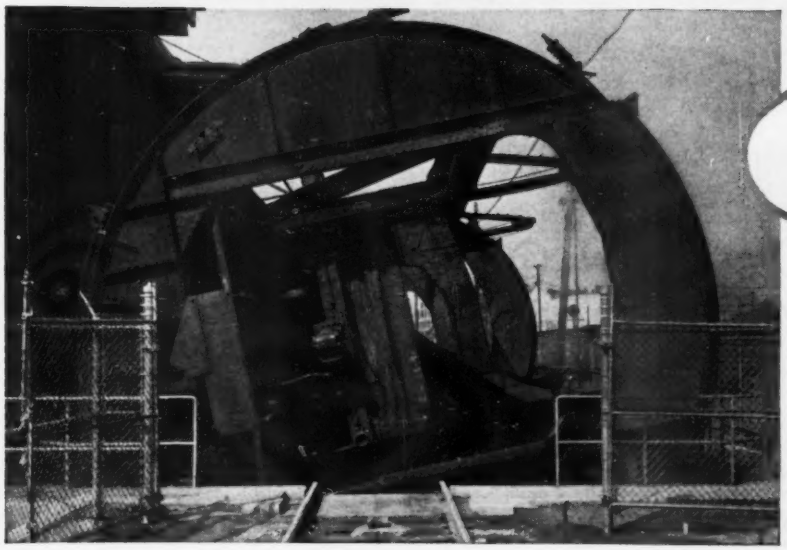
LEEDS N NORTHRUP
instruments automatic controls • furnaces

Jrl. Ad ND16-91(3)

Why Link-Belt builds both...

Car Shakers

EASIER ON CARS with minimum noise level . . . thanks to exclusive low-frequency vibration. The Link-Belt Car Shaker helps hopper cars empty themselves. Even hard-packed loads come "broom clean" in a matter of minutes. Especially good for damp, sticky materials. Write for Book 2345.



Rotary Dumpers

BOTTOMS UP . . . empties 90 ton car every 60 seconds or less by simply turning car upside down (including return to upright position)! That's how fast Link-Belt Rotary Car Dumper unloads gondolas. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

Read how you can empty railroad cars fast, gently—at lower cost

YOU'LL get push-button car-unloading with either the Link-Belt automatic Rotary Dumper or the low-frequency Car Shaker. Both of these Link-Belt products can whisk gondola cars "broom-clean" in a remarkably short time.

We build the Rotary Dumper for large users . . . the Car Shaker for smaller operations. That's why you can be sure you get the right railroad car unloader for your particular requirements. Each of these precision-engineered products reduces operational hazards, minimizes injury possibilities, cuts costly demurrage charges.

If you empty a few gondola cars a day—or several thousand a week, call the Link-Belt district office nearest you. Get all the facts on how you can cut your railroad car unloading costs.

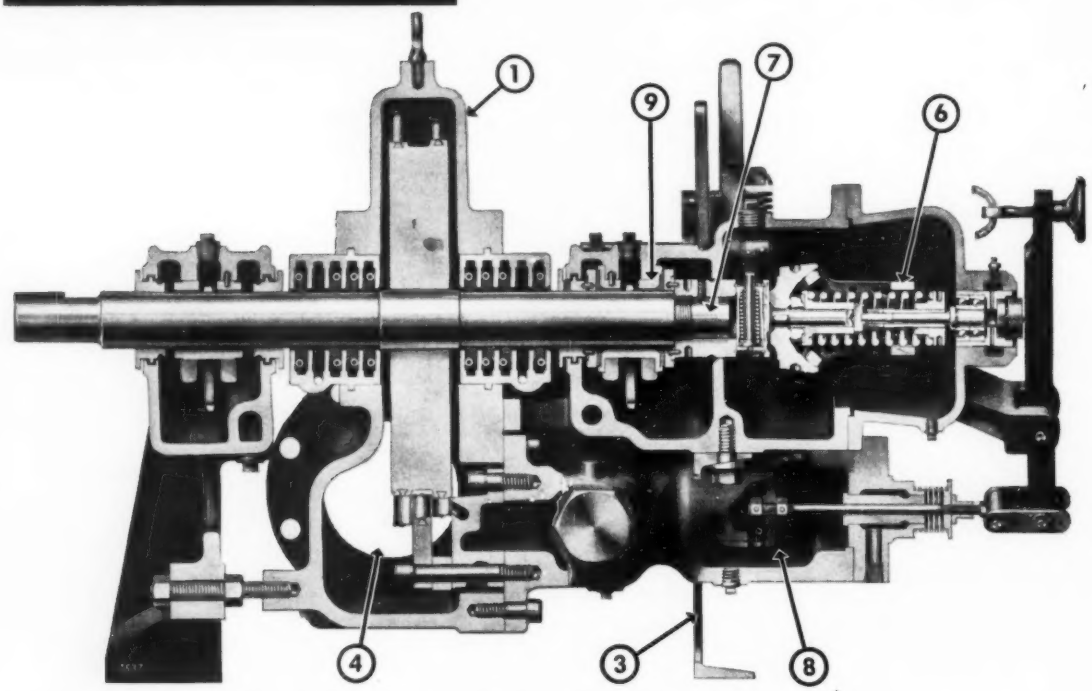
LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,202

NEW DE LAVAL HCB SINGLE STAGE TURBINE

can be ordered from stock



1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. *Not shown.*

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is *removable* for cleaning without breaking steam connections. *Not shown.*

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now *replaceable as a unit.*

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2"–250# ASA FLG.
Exhaust: 6"–150# ASA FLG.
Weight: 1,200 LB

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the removable steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—*at low cost*—a variety of applications in your plant.

Send for new Bulletin 4206
which gives vital facts and figures

DE LAVAL *Mechanical Drive Turbines*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

DL-205

Power

SEPTEMBER 1953 • VOLUME 97 NUMBER 9

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, which is available for 50¢ from the editorial offices.

COAL HANDLING can be colorful as well as efficient—at least that's what our cover picture seems to prove. Painted at Sunbury Station by Carol Dudley Prichett, it's one of Pennsylvania Power & Light Co's collection, "Portrait of Power."

As we told you when we ran the first of these paintings (March 1952), they're the work of members of the Lehigh Art Alliance. With brush and color, this group is recording its impressions of Pennsylvania industry. Of 99 paintings made at Sunbury, 25 were selected to form the PP&L collection, which has been shown widely. With the co-operation of PP&L, we've been able to present three of them to you—the March and October 1952 covers and now this water color of a rotary car dumper.

Next month . . .

■ In the extra Mid-September issue you'll find the 1953 Modern Plant Survey—tabulated technical details on over 500 new central stations and industrial steam plants, 125 hydro projects. And graphic summaries of today's trends in power-plant design.

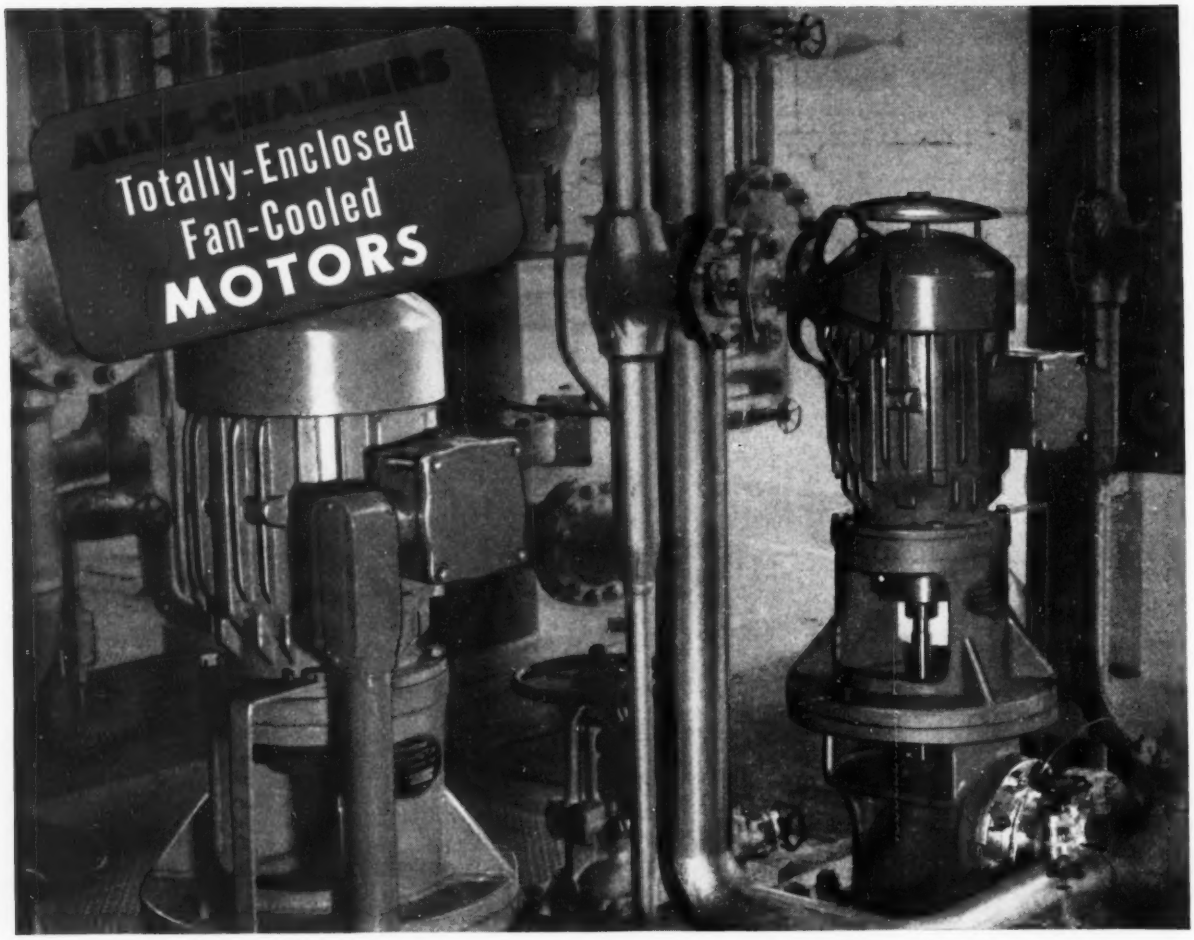
■ This same extra issue will also bring you the Renovation Roundup. It's packed with tested ideas for modernizing all the power services.

■ Then comes the regular October issue with its special report on electrical practice in today's industrial plants. To gather material for it, Associate Editor Jim O'Connor talked to more than 175 experts in 40 companies scattered over 11 states.

■ The result of this fact-finding expedition is a 52-pg distillation of the latest thinking on power supply, distribution and utilization. You'll want it at your side when you plan a new plant or start to modernize your present electrical system.

. . . and future months

■ Remember the step-by-step picture stories on rewinding induction motors? We've just done the same kind of photo record of a turbine overhaul. Steve Elonka supervised "shooting" and he's readying the pix for an early issue.



Get These 3 Low Maintenance Features

1 Wide Open Air Flow

No enclosed external air passages to clog. Easy to clean with cloth, brush, air hose or vacuum. Simply remove fan cover and whole radiating surface is exposed for inspection and cleaning.

2 Cast Iron Construction

Frame, conduit box and fan cover of cast iron resist corrosion. Fan is non-sparking, corrosion-resistant material. Well suited to outdoor operation.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

3 Pre-lubricated Bearings

Ball bearings are double-shielded type, pre-lubricated at the factory. Periodic lubrication is not required under normal operating conditions, but provision is made for in-service lubrication if necessary.

GET COMPLETE INFORMATION on Allis-Chalmers motors for indoor and outdoor service — complete with Allis-Chalmers coordinated control — from your nearby A-C Authorized Distributor or District Office, or write for Bulletins 51B7286 and 51B7149. Allis-Chalmers, Milwaukee 1, Wisconsin.

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CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

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...with Power readers...

THE BIBLE AND POWER . . .

One of the many ways we keep tabs on how POWER readers feel about the editorial service we render is to send a query when a subscriber fails to renew. A gratifying number take the time to tell us why. As you might expect, a few find our editorial content doesn't meet their particular needs. But most tell us they aren't renewing for routine reasons—they're changing jobs, entering military service, retiring, etc.

From this last group—those who are starting a well-earned rest after long years in the power field—we get some mighty interesting and heart-warming letters. One received recently made us feel so good we can't resist sharing it with you.—ED.

I retired from the Bureau of Yards and Docks last November. Am 68 years old this year. Previous to retirement, my guides were the Bible and POWER *magazine, the leading magazine in my special trade, through which I attained to the head of the Mechanical Specifications Section in the Bureau of Yards and Docks.*

My work on earth is nearly done. From here on, I'll get along with the Bible. I can honestly recommend POWER *magazine to anyone connected in any way to the generation of power* on the earth—*power* between heaven and earth *is something else.*

Washington, D. C. E W SMALLMAN

...lines and bylines

PIONEERING in operation of steam power on gas-transmission lines comes easily to L L Nunley, a steam man all his life. Born in the Texas Panhandle, he attended Amarillo High School and studied engineering at Lubbock Technological Night School for two years. This training was later rounded out by completion of the ICS course in power-plant engineering.

L L Nunley

Beginning in 1931 as a clean-up boy, Nunley began to pile up experience in all phases of steam-power operation, maintenance and management. Step by step he moved up to the post of chief engineer in an Oklahoma steam-electric station. With that background he swung over to his present post as superintendent of Transcontinental Gas Pipe Line Corp's Station 5, about which he tells you on pp 73-76.

Nunley's hobbies are photography and electronics. We'd hazard a guess that he gets plenty of chances to put the latter interest to work among the many electronic devices now used on pipelines.

DATA SHEETS have been a popular feature of POWER for over 20 years—the one pictured in miniature at the right is No. 254! Some of them have been designed by our own editors, but most Data Sheets come from readers who've developed them to save time in making routine calculations or to collect useful constants in handy form.

Data Sheet No. 254

Now's a good time to join the parade of Data Sheet contributors—and, incidentally to earn a $35 check for each one accepted. We want to build a backlog, will welcome contributions.

There's almost no limit on subject matter. Look back at past Data Sheets and you'll see they cover everything of interest to a power man—from fundamentals right through fuels, combustion, steam generation, piping, heating, air conditioning, refrigeration, electricity, etc.

PACKAGE BOILERS are F F Hohnholt's prime interest these days. As manager of Package Generator Sales for Foster Wheeler Corp, he's had a lot to do with the growing application of this type. And out of his experience, he passes along some good tips (pp 77-79) to help you select the right unit.

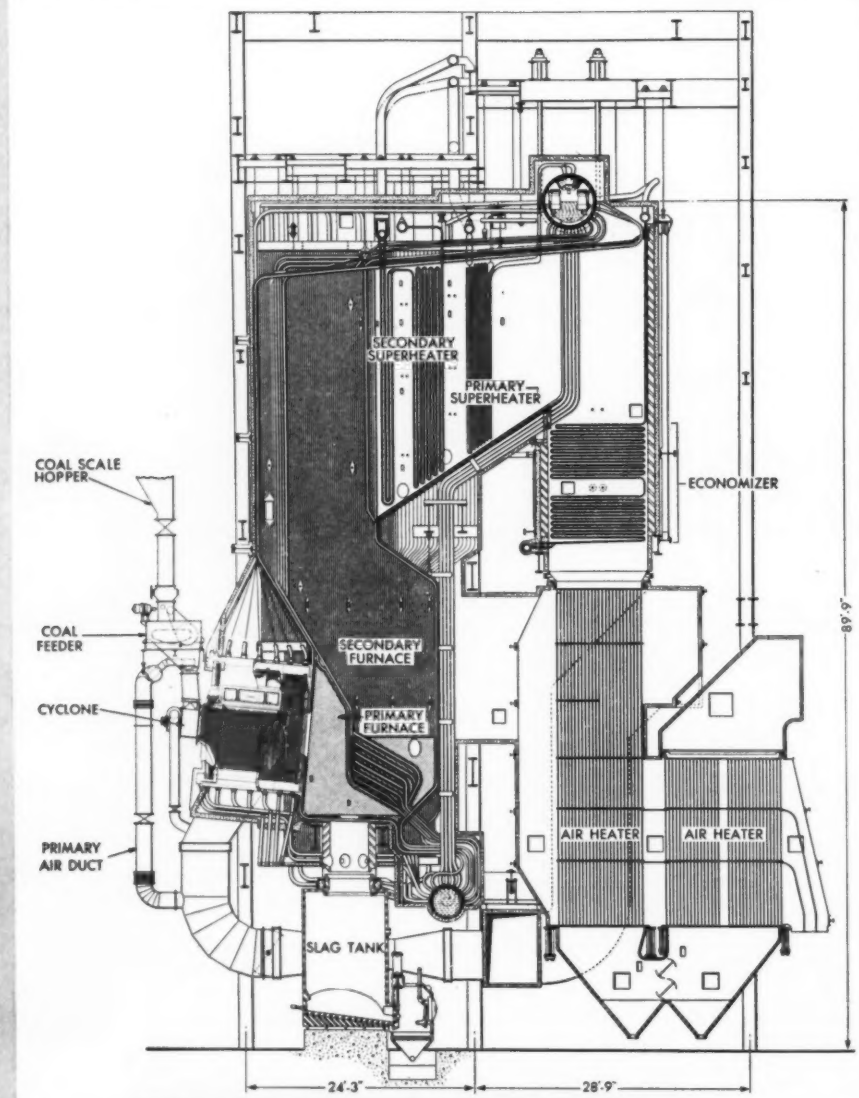
F F Hohnholt

Civic activities have been another great interest. Frank served for two elected terms (6 yr) as councilman of the Borough of Leonia. He represented the borough and was chairman of the Overpeck Creek Valley Sewer Survey Committee. Their reports and findings resulted in formation of the Hackensack Valley Sewer Commission and the building of a trunk line and sewage-disposal plant for this area of New Jersey.

A native of the Garden State, Frank was educated in its public schools and at Cooper Union, Mechanics Institute and City College of N. Y. He's a member of NAPE, ASME and SNAME, and is president elect of the Bergen Society of Professional Engineers. Somehow he finds time to play golf, bowl and travel around with a camera.

WISCONSIN POWER AND LIGHT

on the line

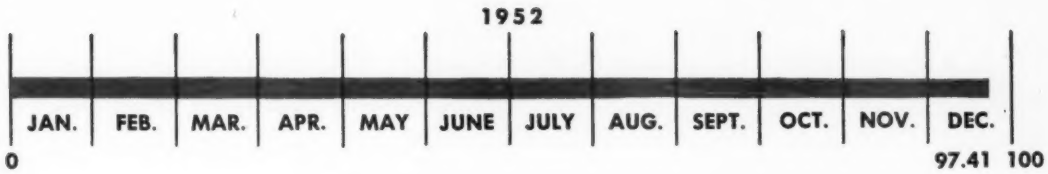


B&W CYCLONE-FIRED RADIANT BOILER

This unit has a steam generating capacity of 600,000 pounds per hour, with superheater outlet conditions of 1325 psi and 960F. It has a design pressure of 1525 psi and employs natural circulation. The boiler is equipped with a superheater, an economizer, and a vertical tubular air heater.

COMPANY'S CYCLONE-FIRED BOILER

97.41% of the year



at EDGEWATER PLANT

This outstanding record for a coal-burning unit was established during 1952 by the operators of Wisconsin Power and Light's Cyclone-Fired B&W Radiant boiler at the Edgewater Plant.

Cyclone Furnaces make a major contribution to high availability because they eliminate so much of the coal preparing equipment that is a source of continuous maintenance and possible outage. Cyclones burn coal that is merely crushed, not pulverized. This means that banks of many pulverizers, with their moving parts, motors, fans, lubricating systems, burners, piping and ducts, are eliminated. They are replaced by a few sturdy, simple Cyclone Furnaces.

Ease of operation and increased safety with the Cyclone Furnace are also important factors that mean sustained on-the-line performance. There are far fewer burners to light with Cyclone Furnaces, and because they use crushed coal, they eliminate the danger of furnace explosions that might occur with powdered fuel.

Further, by keeping the ash where it belongs—in the furnace—and severely reducing the amount of fly ash in the combustion gas, the Cyclone Furnace further contributes to high levels of operation. Ash accumulations on boiler and other surfaces are curtailed, and wear on boiler parts, and on machinery such as induced-draft fans, is greatly reduced.

Increased availability is just one of the many advantages to be obtained from Cyclone Furnace Firing. Other important benefits include reduced atmospheric pollution and a money-saving solution to the fly-ash problem, reduced cost of maintenance, greater efficiency, and boiler-room space savings.

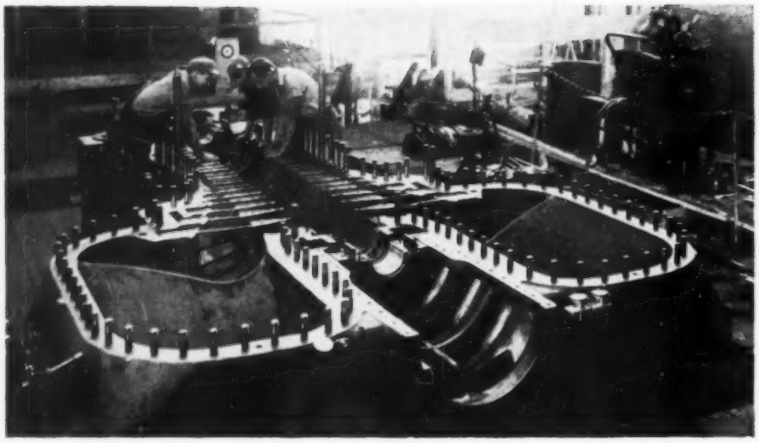
Twenty B&W Cyclone-Fired Boilers are now in operation and have a total accumulated service time of over 50 years. Many other Cyclone-fired boilers are under construction.

We will be pleased to discuss with you the many positive advantages which Cyclone Furnace Firing can contribute to your operations. The Babcock & Wilcox Co., Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

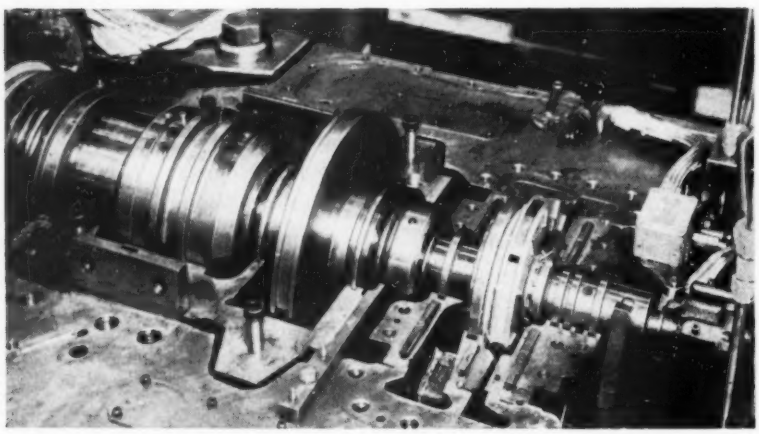
BOILER DIVISION

G-609

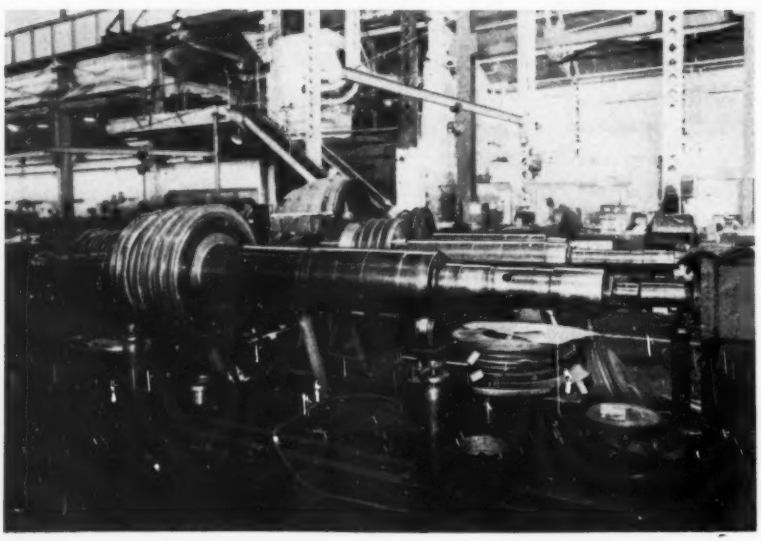


In a turbine alignment is everything. At left the initial factory alignment of bearings, shaft seals, and diaphragms is being checked and recorded so that it can be reproduced in the field, and design clearances established on assembly are maintained in operation.

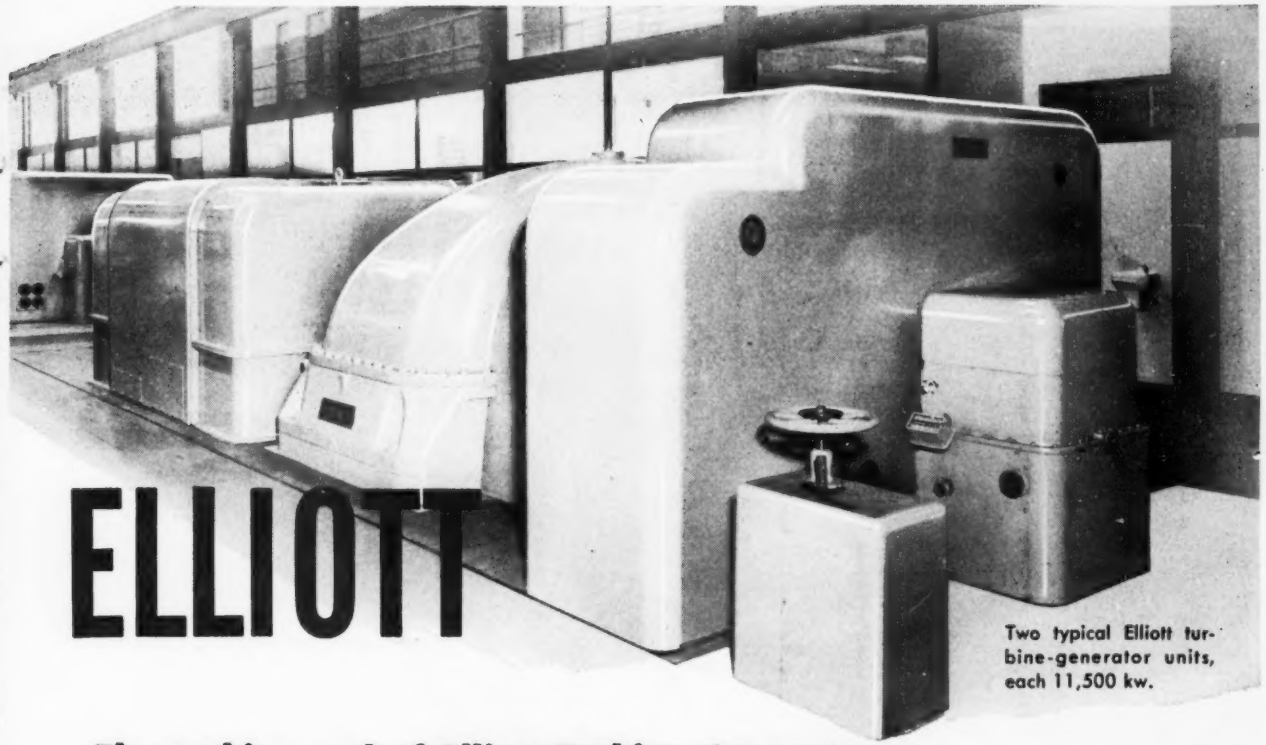
They build them well at



The steam end bearing case is arranged as a sliding pedestal to take up axial expansion. It carries the No. 1 bearing, thrust bearing, shaft-mounted main oil pump, overspeed trip pin, and speed governor. The centrifugal oil pump at 3600 rpm provides the reserve needed by the hydraulic control system, including sudden demands for large quantities of oil to move the valve servo motor on sudden load changes.



In turbine rotors initial temperature shocks in the first stages cause faster expansion in the disc than in the shaft. This would tend to relieve a shrink fit, thus upstream wheels for Elliott large, high-temperature turbines are forged integral with the shaft. In later stages temperature changes in disc and shaft are more nearly uniform, and the problem is replaced by that of higher stress due to the larger diameters and heavier blading. This increased physical stress is met by using special alloy discs shrunk on the shaft. Such individual discs have higher physicals than can be obtained in the large shaft forging and are therefore best suited to the higher blade loads, and with the low temperatures in these down-stream stages temperature changes do not affect the shrink fit.

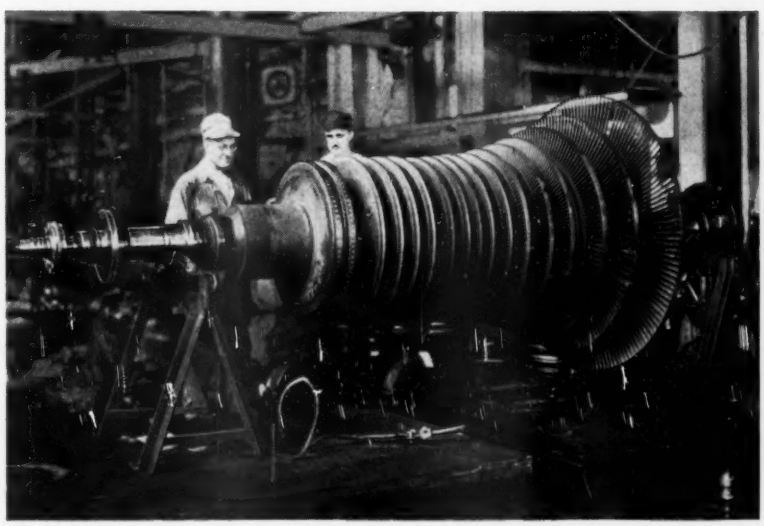


ELLIOTT

Two typical Elliott turbine-generator units, each 11,500 kw.

The turbine end of Elliott Turbine-Generators exemplifies the extreme care and high degree of engineering skill that has become known as characteristically Elliott. Look over the pictures on these two pages—they speak for themselves. For full data on completely Elliott-built turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company
Steam Turbine Dept.



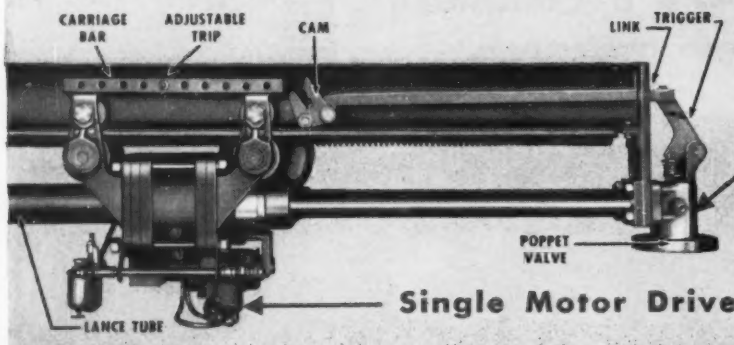
With the many physical and chemical checks on material going into the finished rotor, is the final inspection after the shake-down run at speed and overspeed on the test block. While material control during each step in manufacture minimizes the hazard of test operational failure, the final proof of the rotor lies in black light inspection for cracks in shrouding and other parts.

H3-3

ONLY DIAMOND Model IK BLOWERS GIVE YOU THESE THREE

The Diamond Model IK Long Travel Retracting Blower does an efficient job of cleaning tube banks of all kinds. It is particularly suited to locations where gas temperatures are too high for permanently installed multi-nozzle blower elements. It cleans by action of powerful jets [illegible] rotating lance tube. The close, radial blowing pattern (a sweep every inch) thoroughly cleans soot, dust, and most slag deposits over a wide radius.

The three features described here are all vital to the economy and dependability of any long retracting blower. ONLY Diamond Model IK gives you these THREE.



Single Motor Drive

A single motor simultaneously propels the carriage and rotates the lance tube through a rugged system of gears. This represents the ultimate in simplicity . . . the last word in reliability. There is only ONE set of motor elements, ONE set of control elements and ONE set of connections to power supply. Motor can be air or electric.

Mechanically Operated Valve

Control of the air or steam used as the blowing medium is automatic, positive and accurate in Model IK by means of a simple mechanically operated valve. As the carriage begins to move the lance tube into the boiler, an adjustable trip on the carriage bar engages a cam which opens the valve through a linkage. As retraction of the lance nears completion, the trip reverses the cam, closing the valve. All pilot or diaphragm valve elements are eliminated. Adjustable trip can be moved left or right to open valve earlier or later.

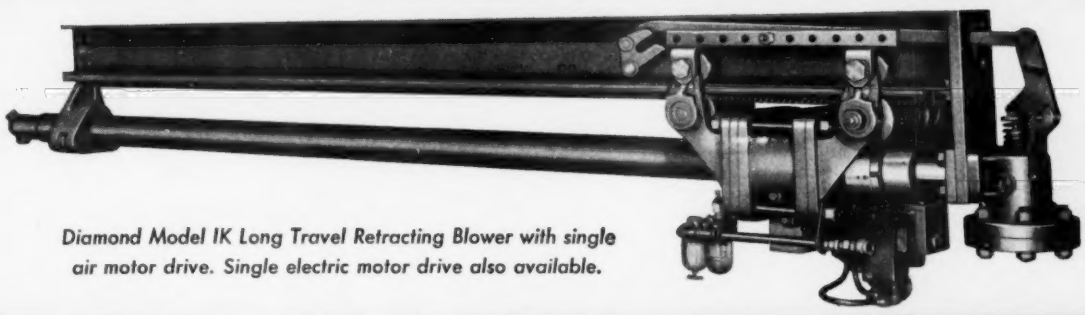
50th ANNIVERSARY 1903-1953

DIAMOND POWER SPECIALTY

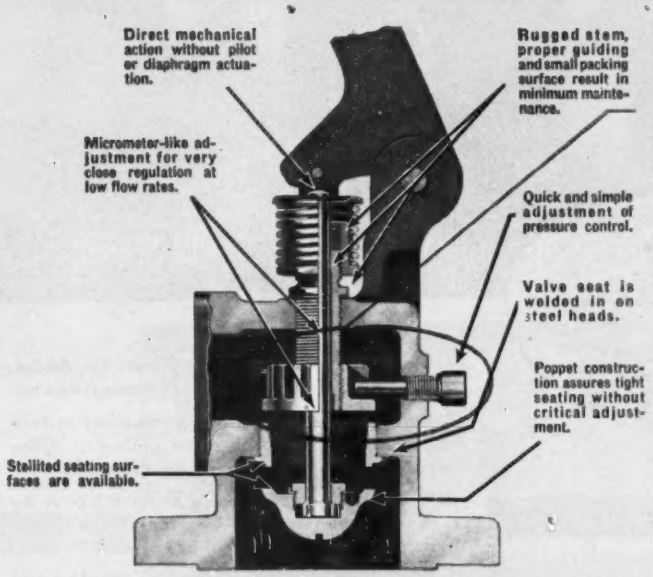
SINGLE MOTOR DRIVE

MECHANICALLY OPERATED VALVE

ADJUSTABLE PRESSURE CONTROL



Diamond Model IK Long Travel Retracting Blower with single air motor drive. Single electric motor drive also available.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Stellited seating surfaces are available.
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Quick and simple adjustment of pressure control.
Valve seat is welded in on steel heads.
Poppet construction assures tight seating without critical adjustment.

Adjustable Pressure Control in Poppet Type Valve

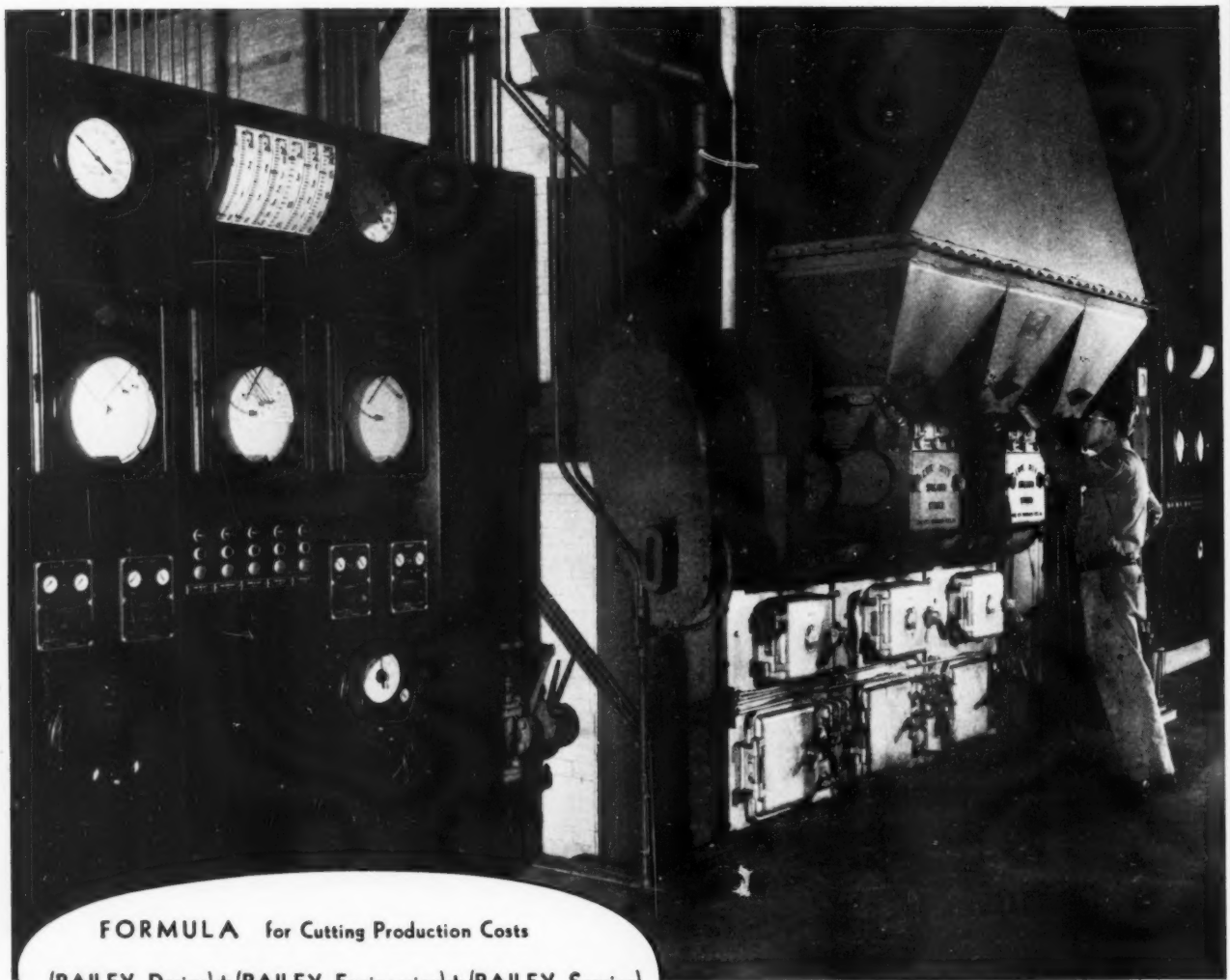
Easily and quickly adjusted, the control consists of a ribbed disc carried on the threaded valve stem guide. Its location outside the path of valve travel prevents interference with full and immediate opening of the poppet valve . . . avoiding wire drawing. Throttling is at the back seat so that the main seat is spared the damaging action of this duty. No orifice is required in the line. This feature provides the means for greatest blowing economy for each individual blower.

ASK FOR NEW BULLETIN 1080

CORPORATION LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

How to Cut



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

At the heating plant of Lincoln Electric Co., Euclid, Ohio Bailey Control helps to cut operating costs by:

1. Controlling the rate of combustion in two spreader stoker-fired hot water boilers to maintain the desired temperature of outlet water.

2. Controlling fuel-air ratio at each boiler by means of a unique Btu-Air Flow meter which maintains most economical use of fuel.

3. Controlling quantity of water by-passed around boilers, thus tempering water supplied for heating in accordance with changes in outside temperature.

Operating Cost

★ When your plant is operating at peak efficiency, unit production costs are low. But outages of any kind upset the balance. As efficiency drops, and/or outages occur, overhead costs impose an increasing burden—bring on dollar losses that can't be recovered.

That's why you can use Bailey Co-ordinated Control Systems to advantage. Here are three reasons why Bailey systems are the best you can buy:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's sales service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

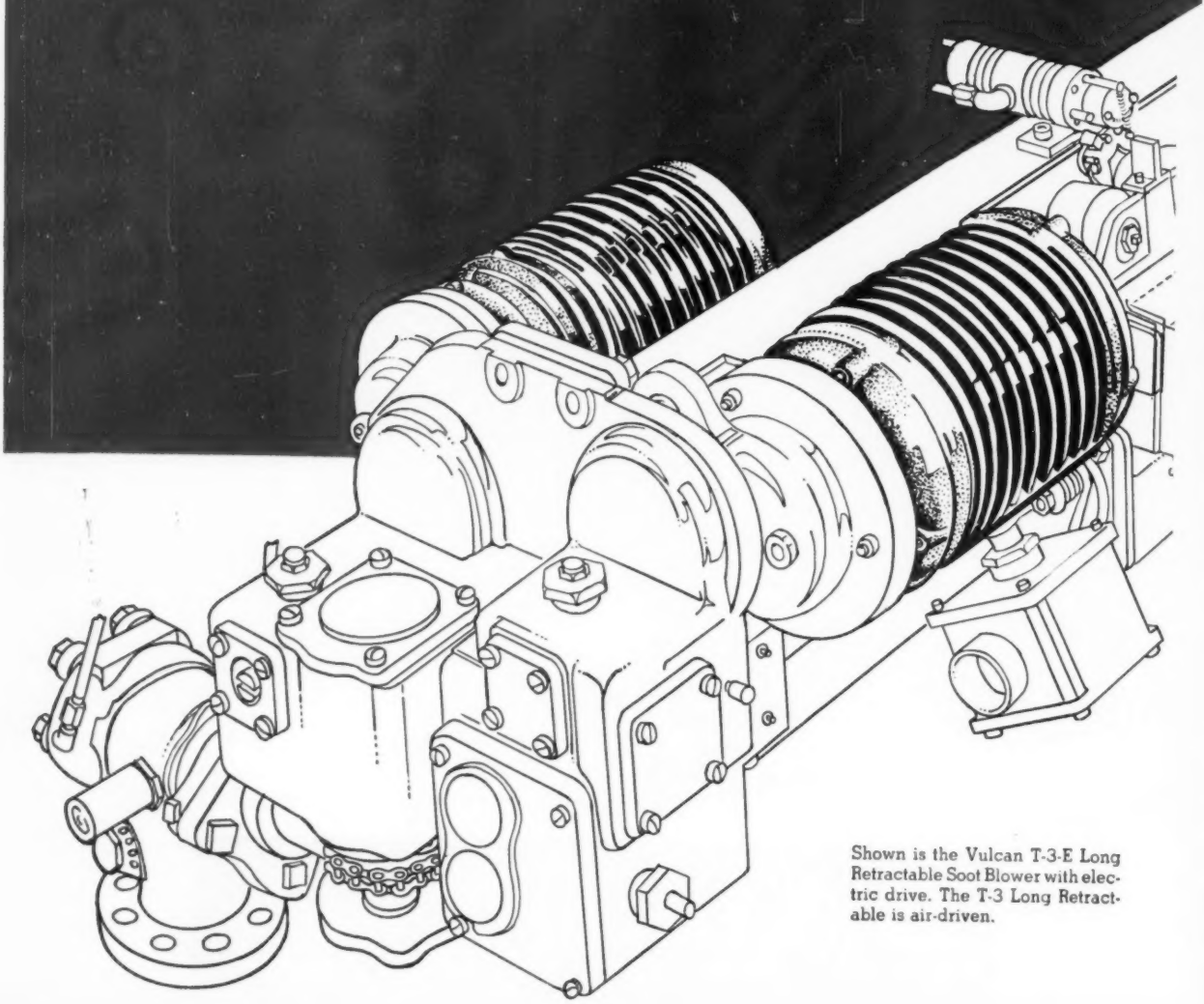
For lower operating cost—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-119A-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

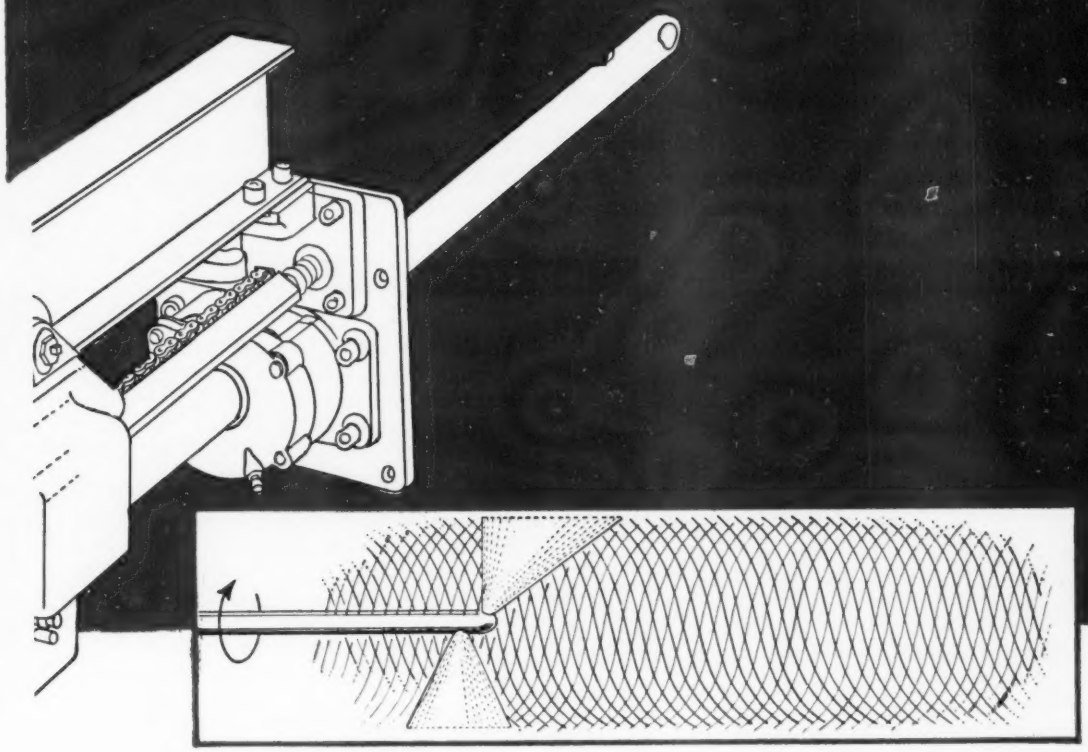
WHY VULCAN



Shown is the Vulcan T-3-E Long Retractable Soot Blower with electric drive. The T-3 Long Retractable is air-driven.

VULCAN *Automatic*

USES 2 MOTORS



This cleaning pattern—an infinite number of double-helix paths—makes the second motor of a Vulcan Long Retractable Soot Blower a most profitable investment. Two motors cost more—but they are worth more.

To get such thorough cleaning—with the blowing steam or air always cleaning a new path—you must have two motors. One motor moves the lance in and out—the other rotates it. And with the two motors, traversing and rotating speeds are independently adjustable for your exact needs.

This double-helix pattern cuts tube replacement costs. There is no danger of the blowing medium constantly striking—and wearing away—the same part of each tube. Packing life is increased.

These are reasons why Vulcan "Long Retracts" are found on so many new high-duty boilers. Users know Vulcans pay for themselves quickly and often. The story is told in Bulletin 1002. Write for it.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

HOW TO FIGURE THE COST OF STEAM TRAPS

STEAM TRAPS are something like wives. First, there is the cost of securing one and installing it in its new home. Then, there is the cost of maintaining it. Now, everyone knows that some wives are frugal and help their husbands a great deal, while others are frivolous spendthrifts. It is the same way with steam traps. You have to figure the original installed cost, the maintenance cost and the effect on general operation.

Divide the total expenses by life of the trap and you get down to the real heart of the matter—the *cost per year.* This is where Armstrong steam traps really shine! Let's take a look at the details:

DIRECT TRAP COSTS

1. First Cost. The price of Armstrong traps is low in terms of capacity. An optimum relationship between leverage, bucket weight, bucket travel and orifice size gives big capacity in a small package. Armstrong steam trap capacity ratings are based on *actual* tests with condensate at steam temperature and with actual hookups. They tell you what the trap will deliver *on the job.* This is not generally the case with other trap ratings.

2. Installation Cost. In four of the most widely used sizes, Armstrong traps are available in either side inlet—side outlet or bottom inlet—top outlet body styles, making possible the simplest, lowest cost installation.

3. Maintenance Cost. 40% less maintenance with Armstrong traps is the average of all the maintenance reduction reports secured from users over a period of years. This is due to high quality of parts, generous safety factors and inverted bucket know-how.

4. Repair Parts Cost. Armstrong heat treated chrome steel valve parts, precision ground and lapped, last a long time. When they do require renewal, a complete new valve mechanism right off the factory production line transforms an old trap into a new one at low cost.

INDIRECT COSTS

1. Cost of Steam Waste. This cost occurs through leaky trap valves, through traps that stick open or lose prime, through extra hours of operating heat transfer equipment due to poor drainage. This is a cost you can eliminate with Armstrongs.

2. Cost of Efficiency Losses. Poor trapping cuts heat transfer efficiency. Figure how much 10% loss affects the return on a $5000 production unit, or a $1,000,000 plant. Armstrong traps discharge condensate and air as fast as it accumulates, keep steam equipment at peak productive efficiency.

3. Cost of Downtime. Armstrong traps stay on the job long and faithfully, eliminating the production losses caused by excessive downtime for maintenance.

A steam trap casts a mighty big shadow that is multiplied by the number of traps in a plant until it has a major effect on operating costs. When you figure the costs from all angles you will find it pays to specify "traps shall be Armstrong."

FREE: **STEAM TRAP BOOK**

—44 pages of prices, design, selection, installation and maintenance data on Armstrong steam traps. You are welcome to a copy. Call your local Armstrong Representative, or write.

ARMSTRONG MACHINE WORKS

812 Maple Street ○ Three Rivers, Michigan

ARMSTRONG · INVERTED BUCKET · STEAM TRAP

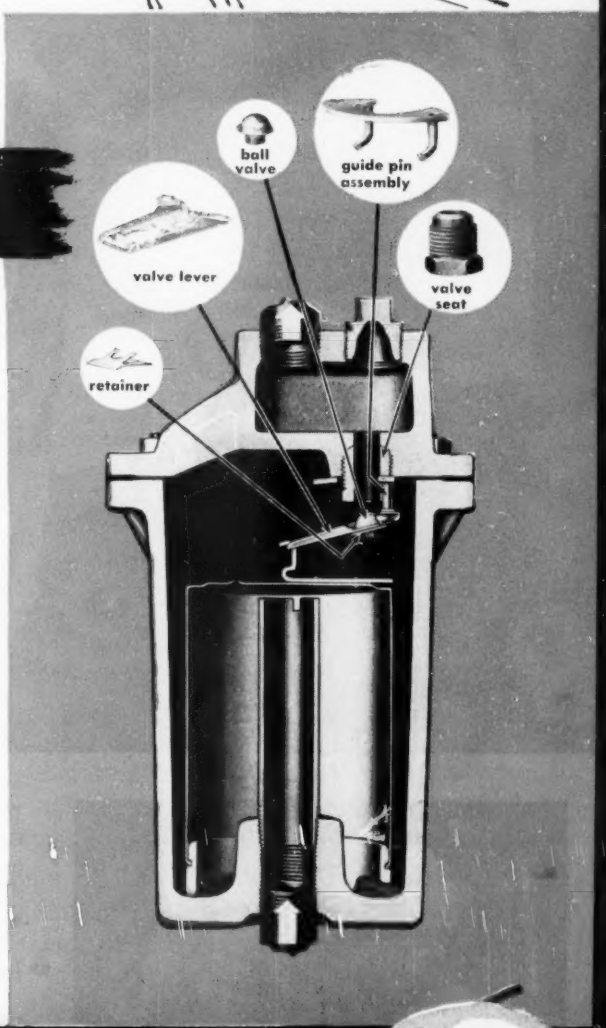
ARMSTRONG

YOU CANNOT BUY A BETTER TRAP THAN AN ARMSTRONG . . .

Here Are Some Questions for Cost Comparison

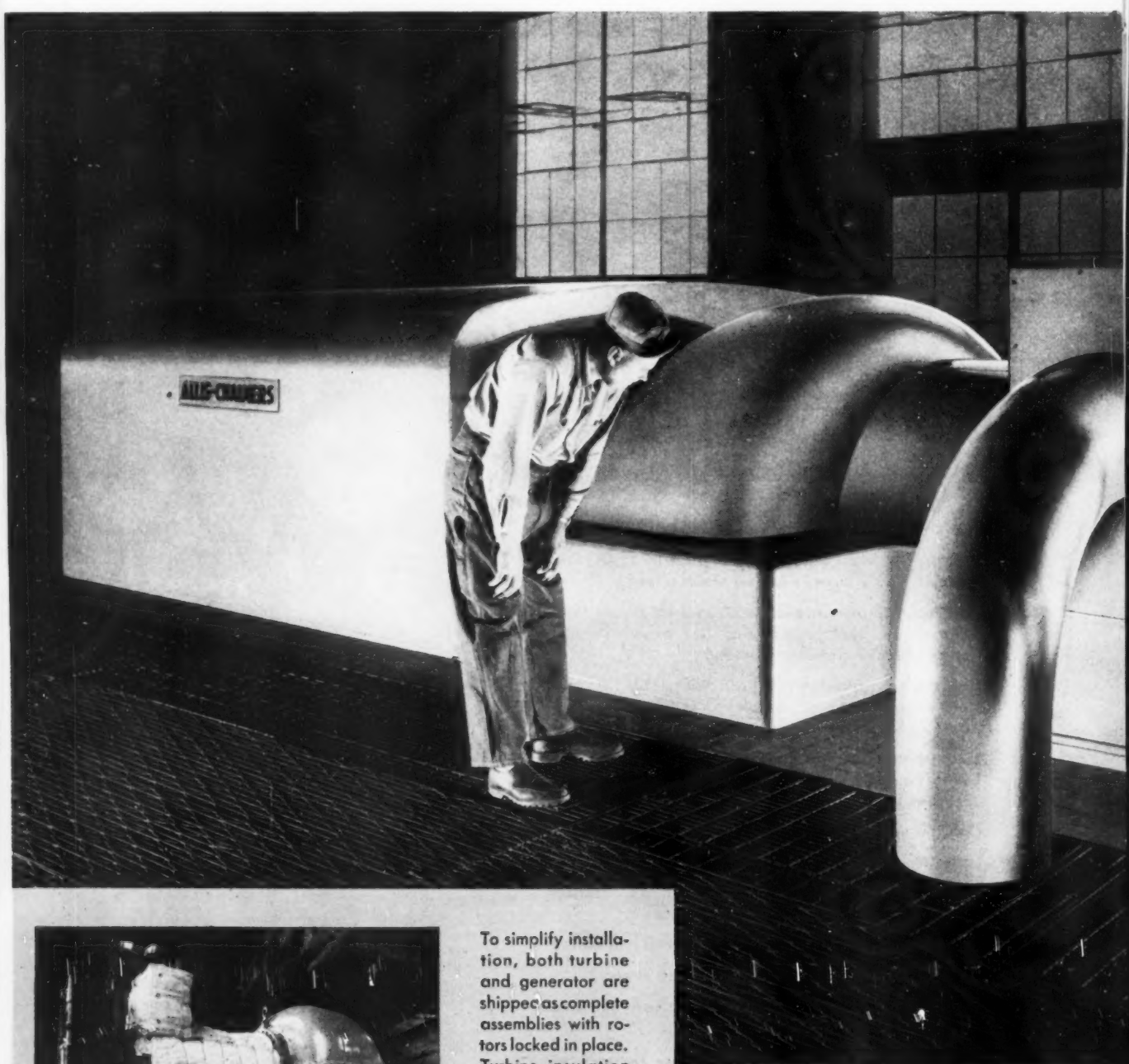
1. Will the valve stay steam-tight for 2 to 3, or even up to 10 years depending on the service?
2. Will the trap discharge condensate at steam temperature to keep equipment hot and minimize non-productive radiation losses?
3. Will the trap automatically discharge air in sufficient volume to keep equipment at peak temperature and to prevent corrosion?
4. Is there enough safety margin of power in the bucket and lever to open the trap when the orifice enlarges slightly due to wear?
5. Can the trap stick in open position?
6. Is the trap apt to lose prime?
7. Are the published trap capacity ratings accurate and reliable for trap selection purposes?
8. Will the trap cleanse itself of ordinary dirt and scale?
9. Is the trap easy to install, inspect and repair?
10. Is the trap unconditionally guaranteed to give complete satisfaction?

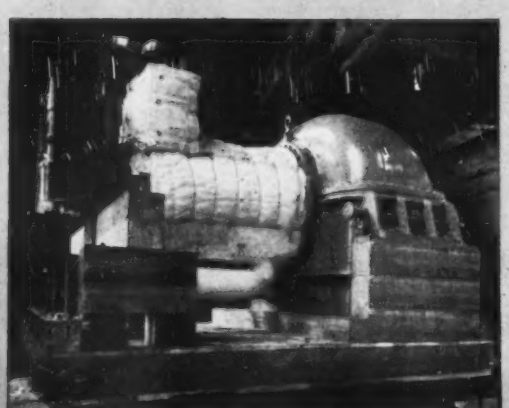
If the trap is an Armstrong, the answer to each of these questions is favorable!



STEAM TRAPS COST LESS!

Another



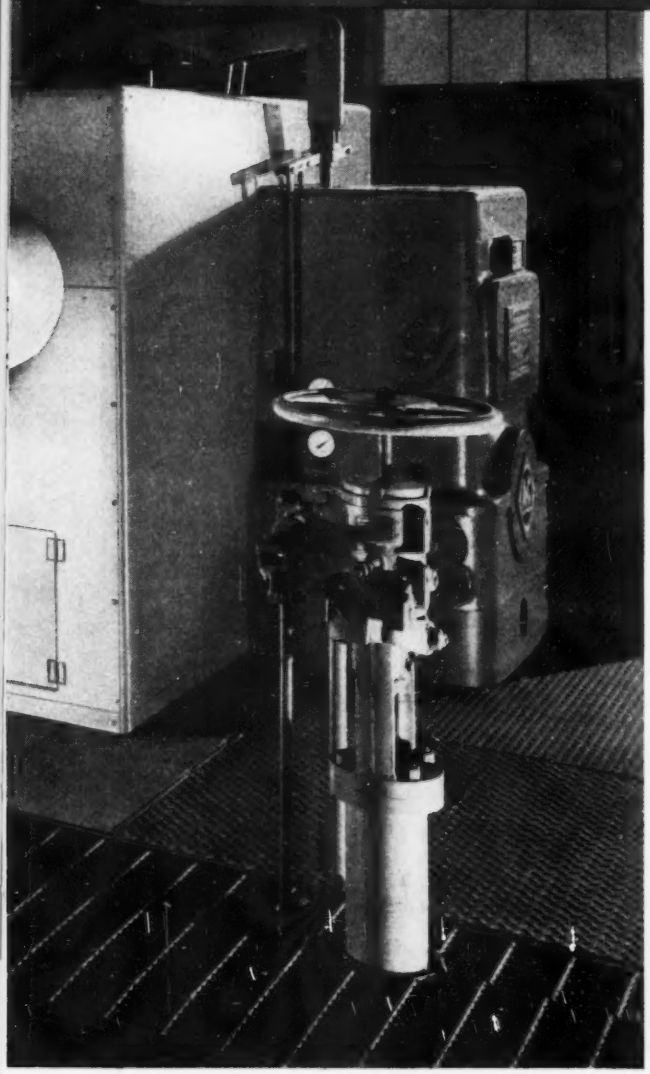


To simplify installation, both turbine and generator are shippec as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series

STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

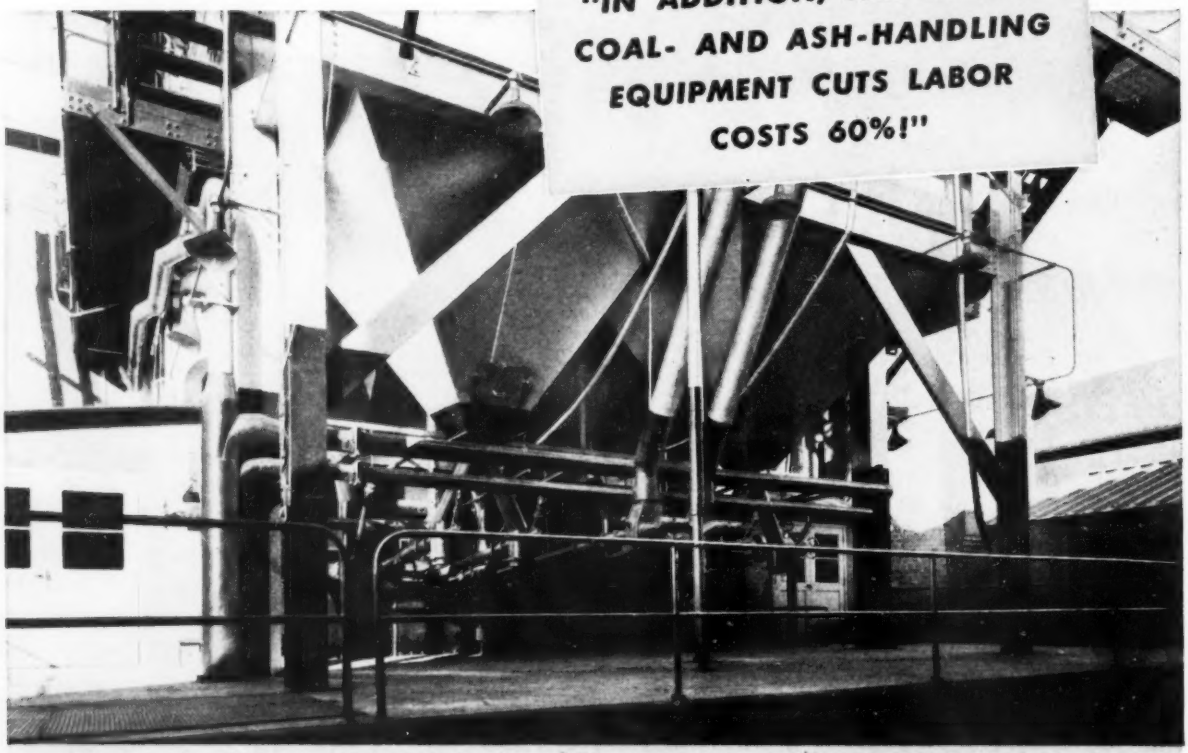
For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

"WE MODERNIZED OUR PLANT, INSTALLED



This view shows how River Raisin has installed its modern fly-ash re-injection system at the rear of the boilers but outside the plant. The plant also features outdoor coal handling to save additional interior space. Coal is delivered to the stoker hoppers through automatic scales which weigh and record the flow.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

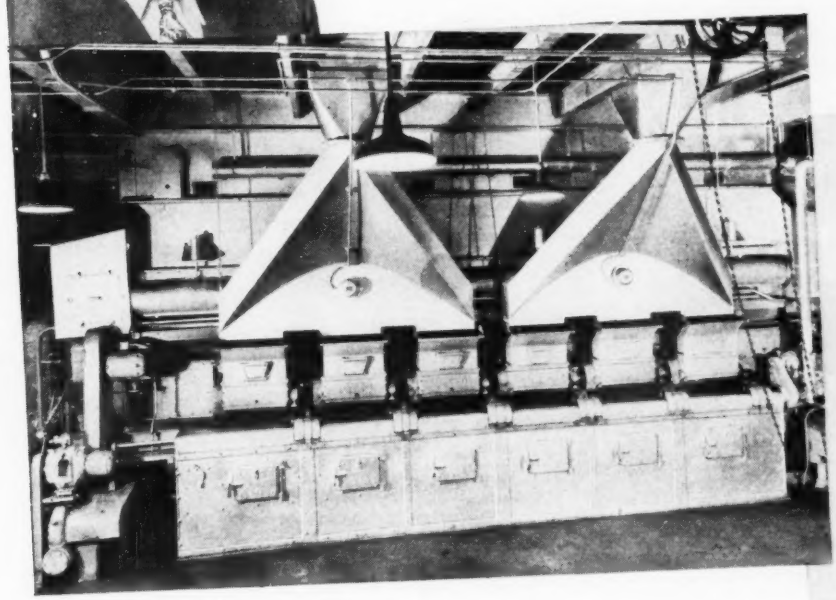
COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY—FOR LOW COST

NEW COAL-BURNING EQUIPMENT, AND CUT OUR FUEL COSTS 45%!"

says Mr. A. J. Goetz, Executive Vice President, River Raisin Paper Co., Monroe, Michigan.

"We recently modernized our entire plant following an extensive engineering survey. New coal-burning equipment was installed...our coal-handling system was redesigned...heat losses were reduced...efficiency raised. As a result, our fuel costs have been cut 45 to 50%—proving to us that for economy and efficiency you just can't beat bituminous coal burned the modern way."



"These modern spreader stokers fully meet the special requirements of our operation. They feature low power requirements, low maintenance, and have the ability to meet fairly rapid load changes. They give us maximum efficiency under all operating conditions."

Modernizing your present plant? Building a new one? In either case it will pay you to get the *modern* facts about coal from a consulting engineer. He'll show you how an up-to-date coal installation can meet your *specific* needs—and at the same time save you more money than you thought possible.

With automatic coal- and ash-handling equipment you can cut labor costs to a minimum . . . and a modern combustion installation will give you more steam for less fuel. Actually, today, you can get from 10 to 40% more power from each ton of coal than was possible a few years ago.

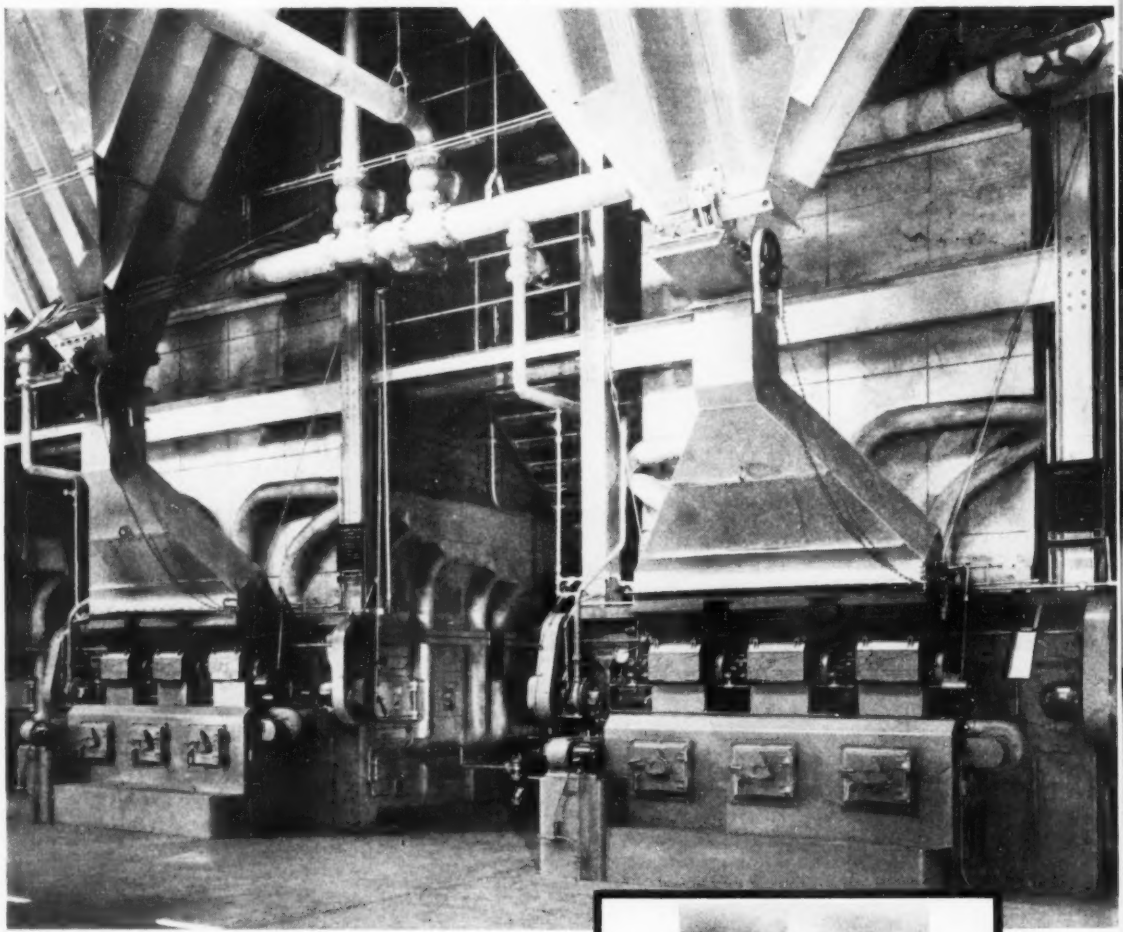
And, if you burn coal, you'll never have to worry about a shortage of fuel. America's coal reserves are virtually inexhaustible, and this coal is mined by one of America's most efficient and productive industries.

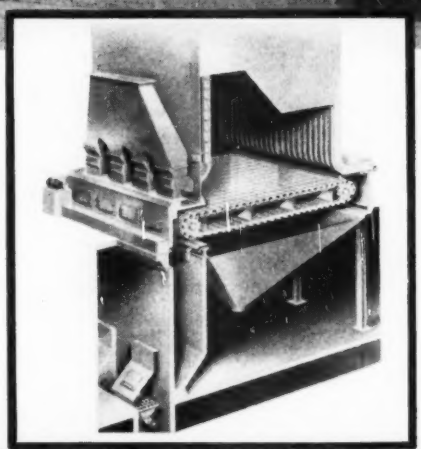
This means that coal users—unlike those committed to other fuels—get the advantage of dependable future supply as well as the most stable prices.

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

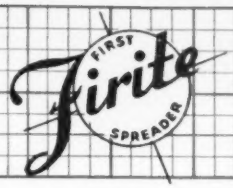
FIRST
Firite
SPREADER





This typical Hoffman installation consists of three 60,000-pound continuous ash discharge stokers. If an emergency occurs, the stokers are proportioned so that any two boilers will carry the normal plant-load of 180,000 pounds of steam.

HOFFMAN COMBUSTION ENGINEERING COMPANY



HOFFMAN
Spreader Stokers

Hoffman built the first forced draft spreader stoker—still the most respected by thousands of owners.

Interested consulting engineers and owners can see Hoffman Stokers in any industrial community — get a list of owners — observe jobs with boilers of similar design and capacities — usually in a similar industry, and, of course, conveniently located.

Whether proposals are being accepted on a combined responsibility basis, or calling for separate proposals on stokers, an opportunity should be afforded to evaluate a Hoffman Stoker bid for any boiler selected.

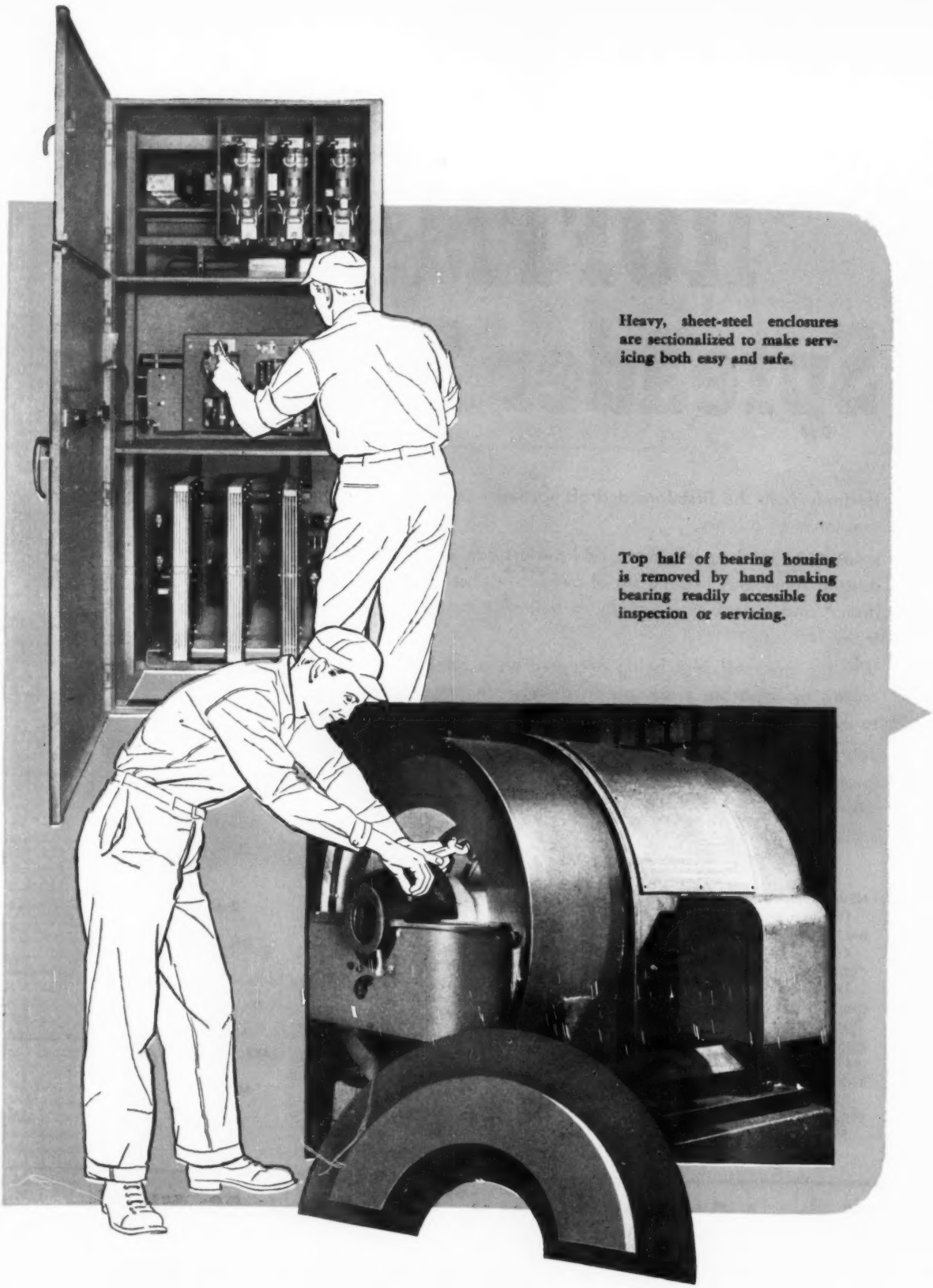
Job references for investigation furnished to registered consulting engineers and interested owners. Our DISTRICT ENGINEERS will not follow up any inquiry except by request.

NATION-WIDE REPRESENTATION

NEW YORK 165 Broadway	WO. 2-5744	LEXINGTON, KY. 126 Westwood Dr.	2-6206
BALTIMORE, MD. 2125 Maryland Ave.	BE. 4740	BUFFALO, N. Y. 54 N. Colvin Dr.	DEL. 8141
COLUMBUS, OHIO 1815 Oak St.	EV. 2570	NASHVILLE, TENN. 123 Third Ave., No.	6-8151
CHICAGO, ILL. 30 N. LaSalle	CEN. 6-7004	RICHMOND, VA. 615 E. Franklin St.	3-5357
BOSTON, MASS. 120 Boylston St.	DEV. 8-9483	CLEVELAND, OHIO 1655 Lauderdale	LAKE. 1-2553
INDIANAPOLIS, IND. 5217 Hinesley Ave.	BROAD. 8086	DENVER, COLO. 1351 Grant St.	AC. 3573
SYRACUSE, N. Y. 520 Robineau Road	76-9752	SALT LAKE CITY, UTAH First So. and Second West	3-5831

General Offices: **Marquette Bldg. Detroit 26, Mich.**

Works: **Fairmont, W. Va., and Detroit, Mich.**



Heavy, sheet-steel enclosures are sectionalized to make servicing both easy and safe.

Top half of bearing housing is removed by hand making bearing readily accessible for inspection or servicing.

This matched pair reduces servicing time to minutes

Every servicing operation from checking bearings to replacing contacts takes a minimum of time—without the usual muss and fuss—on this motor and control team. All components are functional in design and easy-to-get-at. No special tools are required.

On Westinghouse Large Induction Motors you simply remove the top half of the bearing housing by hand and the bearing is accessible for inspection and servicing. No top bracket to remove—no crane to lift heavy, cumbersome parts. One man and a few minutes is all that it takes.

One man can remove the motor's light, sturdy sectional covers and air shields by hand also. Here again, no crane is required—complete operation can be performed in a matter of minutes.

An occasional look in the door meets most of the servicing requirements on this Westinghouse High-Voltage Starter with air-break contactor. Simple, dependable design assures long mechanical life of the contactor and its moving parts.

Powerful magnetic blowouts and large arc boxes effectively confine arcs—increase contact life. Built-in fuses are readily accessible . . . easy to install or replace.

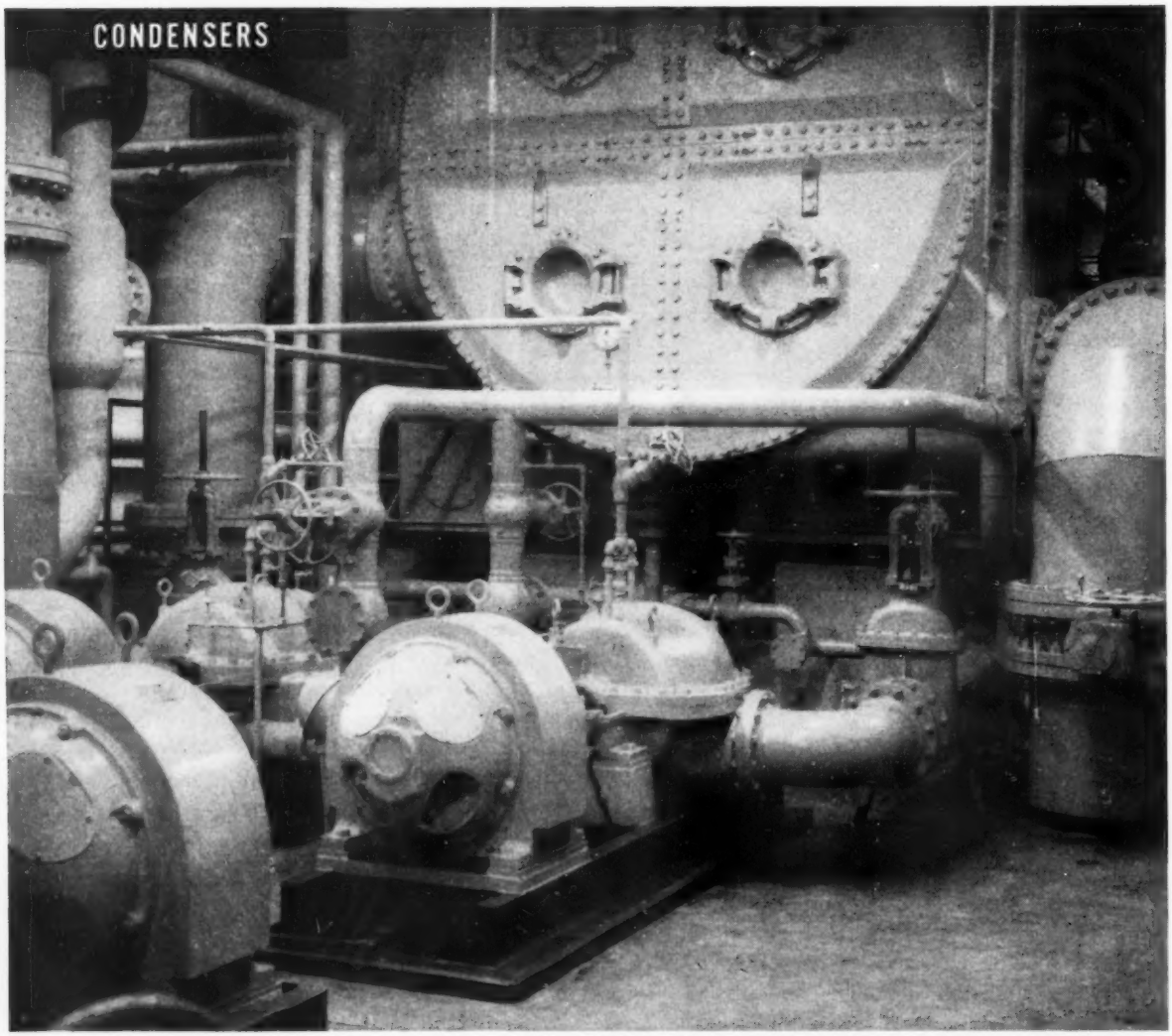
Westinghouse Large Induction Motors and High-Voltage Starters are the perfect power partners. Get the benefits of their co-ordinated operation. Call your local Westinghouse representative now for complete details. Or, if you prefer, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10357-A

YOU CAN BE SURE...IF IT'S

Westinghouse

Worthington Steam

News and information about Worthington equipment for the steam power plant



WORTHINGTON'S 37,500 SQUARE FOOT CONDENSER at Columbus and Southern Ohio's E. M. Poston Station

Shallow wells supply all water for this Worthington-equipped power plant

The E. M. Poston Generating Station of the Columbus and Southern Ohio Electric Company, presently rated at 200,000 kw, gets its entire water supply from shallow wells 7000 feet away from the plant site. A 40-million gallon reservoir stores well water for emergency use.

Worthington equipment at the Poston Station now includes 3 condensers with all auxiliaries, including steam-jet ejectors, circulating water and condensate pumps—also deaerators, evaporator preheaters, and miscellaneous equipment.

Worthington, with over a century's experience in the manufacture of steam power equipment, is equipped to build efficient condensers in sizes to suit any practical limitations. Recently, the largest single-shell condenser in the world—125,000 sq. ft.—was made by Worthington for a large utility.

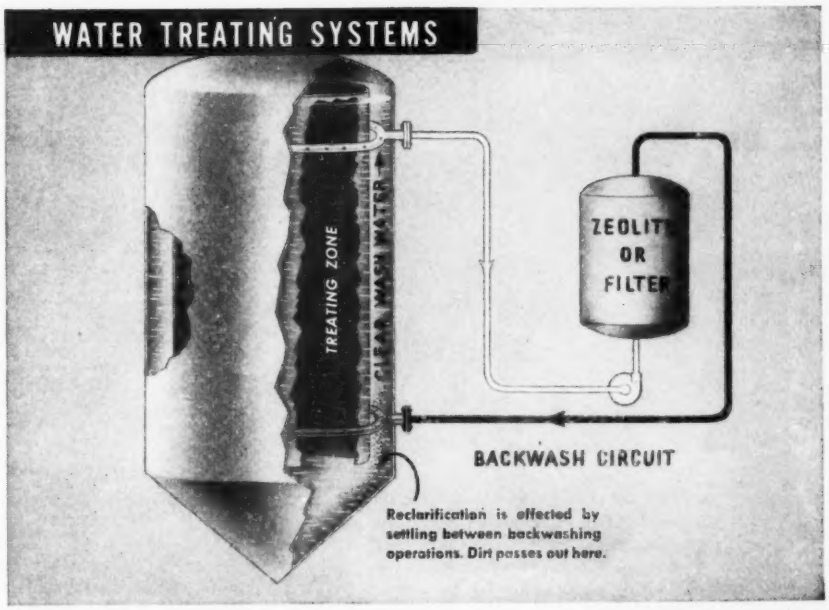
Power Bulletin

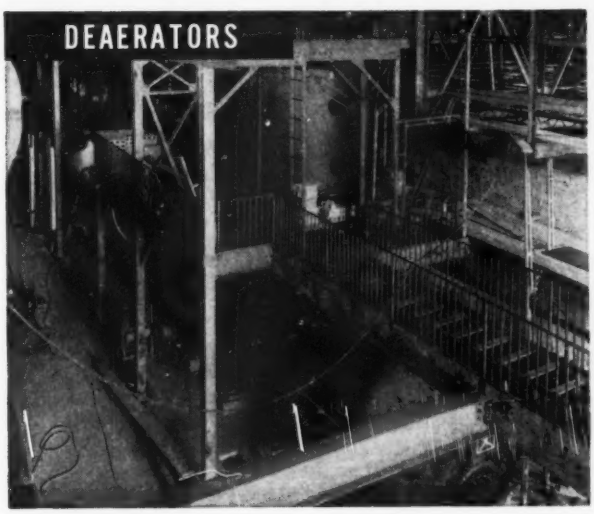
Condensers, deaerators, water-treating systems, and steam-jet ejectors and vacuum pumps as well as turbine generators, mechanical drive turbines and gears, circulating, condensate and boiler feed pumps, pressure filters, and air compressors.

Average Worthington Hot-Z systems pay for themselves in three years

Combining all the best features of hot process and zeolite systems, this Worthington Hot-Z slurry-type deaerating water softener operates on low-priced lime and salt. Studies show that average Hot-Z installations have saved enough in chemical costs to pay for themselves in three years!

Because Worthington makes more of the equipment for all types of water conditioning systems than any other manufacturer, you can be sure you'll get exactly what you need from Worthington. Write for Bulletin W-212 B-7.


WATER TREATING SYSTEMS
TREATING ZONE
CLEAR WASH WATER
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.



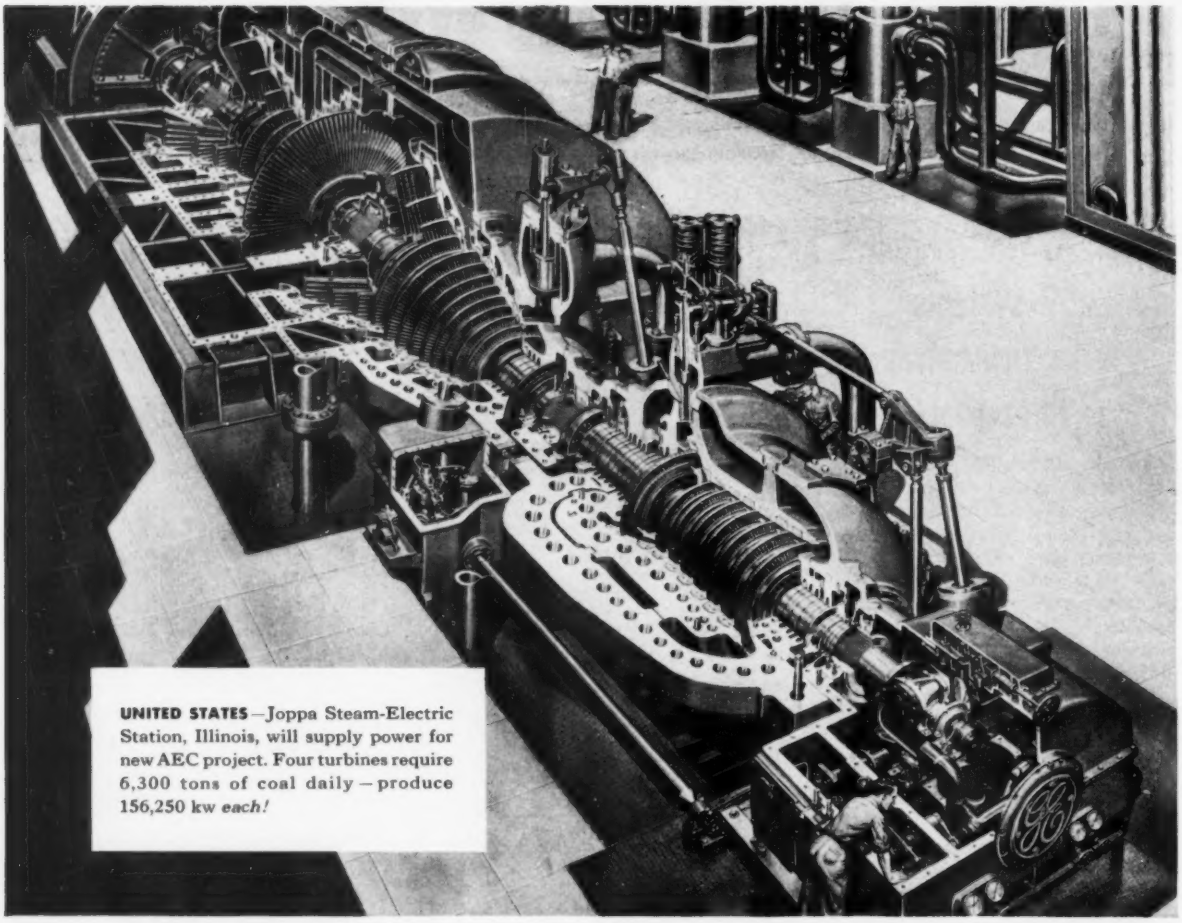
Dayton installs its newest Worthington deaerator

Worthington has supplied the deaerators for each new Dayton Power and Light Company installation since 1936. This new deaerator being installed at the O. H. Hutchings Station, in southwestern Ohio, is one of many Worthington units built in sizes to handle from a few thousand pounds per hour to over a million. Both tray and steam-jet types are made, with external surface-type vent condensers or internal direct-contact vent condensing. With a complete range of sizes and types at their fingertips, Worthington engineers can give you a deaerator exactly suited to your needs.

S.3.1.

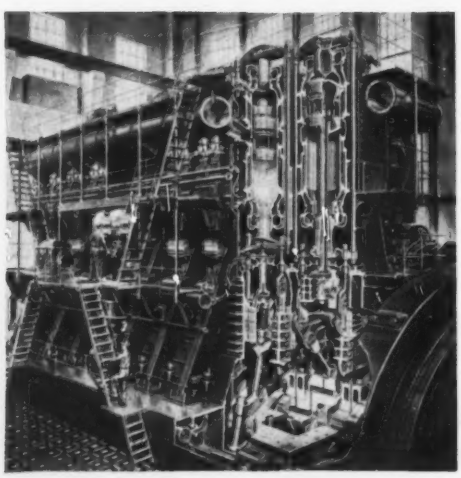
Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.3.1, Harrison, N. J.

WORTHINGTON



UNITED STATES—Joppa Steam-Electric Station, Illinois, will supply power for new AEC project. Four turbines require 6,300 tons of coal daily—produce 156,250 kw *each!*

SEVEN WONDERS OF THE



DENMARK—World's biggest diesel, in Copenhagen, is 38 feet high, 80 feet long with generator and exciter. Eight giant cylinders (33" bore, 58" stroke) can deliver 22,500 hp.—produce 15,000 kw!

Protected by the World's Greatest Lubrication Knowledge and Engineering Service

On these pages are pictured seven of the world's most spectacular electric generating plants—truly seven "wonders" of the power world!

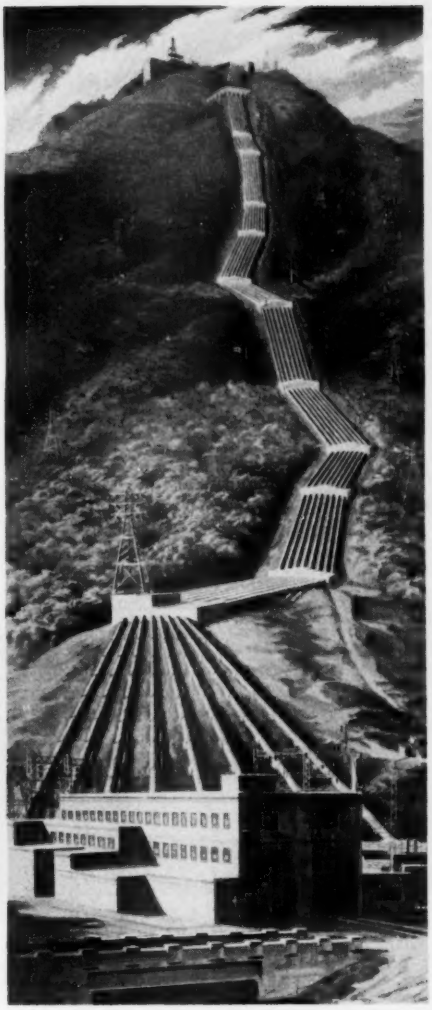
Each is unique—a triumph of engineering science...each contains some of the costliest power machinery. That's why Socony-Vacuum was asked to set up a program of Correct Lubrication for each plant.

There are famous Gargoyle D.T.E. Oils for turbines and and diesels...other special Gargoyle oils and greases for auxiliary equipment...plus skilled lubrication engineering service to go with these products.

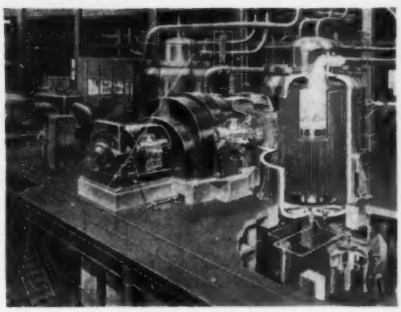
This same kind of unsurpassed lubrication protection is available for *your* plant, mine or mill. Why accept less?

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

BRAZIL—Cubatao power plant, São Paulo, uses river waters—backed up to edge of high plateau and channeled down through mile-long penstocks—to run 8 turbines. Capacity—474,000 kw.

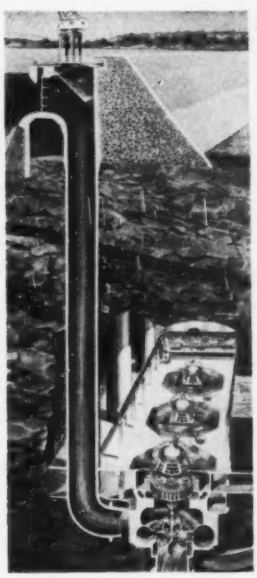


AUSTRIA—Tauern Power Plant, Kaprun, utilizes waters of melting glaciers to run its turbines—will generate 316,000 kw when finished!

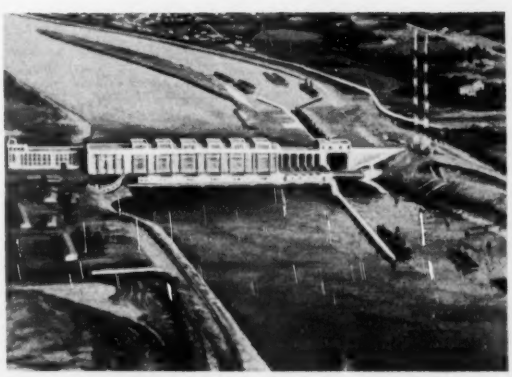


UNITED STATES—World's first mercury unit—power plant teams two 7,500-kw mercury turbines with a 25,000-kw steam turbine. Steam, generated with mercury vapor, is condensed for re-use, runs steam turbine.

POWER WORLD



SWEDEN—Harspranget Station in Arctic, country's biggest, produces 450,000 kw. Water drops 351 feet down vertical shafts to turn underground turbines!



FRANCE—Donzere-Mondragon Power Plant on the Rhone, largest hydro-plant in Western Europe. Six 70,000-hp turbines produce 2,000,000,000 kw hr. annually...an unusual achievement considering the small head, or drop, in the river.

SOCONY-VACUUM

SOCONY-VACUUM

Correct Lubrication

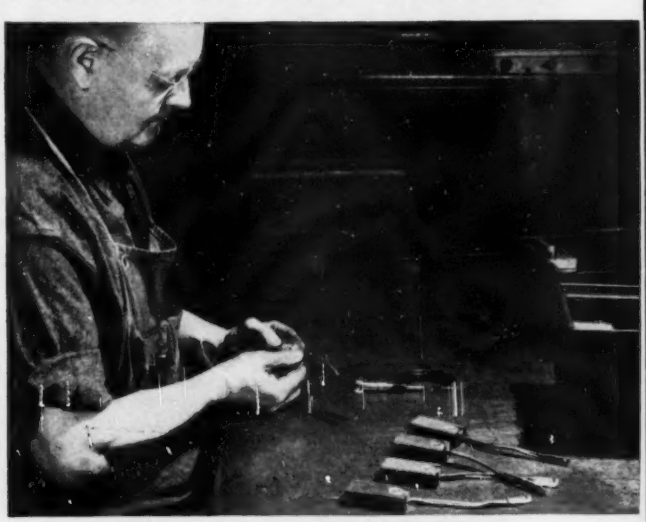
1878 75 1953
YEARS OF ELECTRICAL PROGRESS

ONE OF FIVE 2000-HP G-E SYNCHRONOUS MOTORS USED FOR AIR-COMPRESSOR DRIVES AT FORD MOTOR CO., ROUGE PLANT.

FOUR REASONS WHY G-E SYNCHRONOUS MOTORS

1. STRONG, FABRICATED FRAMES . . .

The welded steel-plate stator frame provides maximum rigidity in a comparatively lightweight construction. The sturdy channel-shaped frame consists of a wrapper plate firmly secured by continuous welds to rigid side plates. This design, proved by years of operating experience, affords more than ample strength for clamping and supporting the stator core.



2. G-E BRUSHES ON G-E MOTORS . . .

Brushes on G-E synchronous motors are a product of G-E teamwork. Close co-operation between machine designers and laboratory engineers means you get the right brush on the right motor for your particular application. In addition to extensive research and testing, all new and improved grades of brushes are thoroughly field-tested before approved for standard use.

Dependable G-E Synchronous Motors on 24-Hour Assembly-line Service

Ford Motor Company uses G-E synchronous motors for air-compressor drives

Compressor-motor dependability is really put to test on 'round-the-clock service at Ford Motor Company's Rouge plant. Compressed air is used 24 hours a day on many assembly operations, and a dependable supply is vital to keep production lines moving.

To furnish this all-important air, five 2000-hp G-E synchronous motors drive reciprocating compressors continuously—with only slight reductions in demand on certain shifts.

G-E synchronous motors can be relied upon for such continuous service with minimum downtime. You can depend on them because in back of every G-E synchronous motor stand more than half a century of motor engineering leadership . . . superior research and testing facilities to assure excellent component materials . . . and a corps of experienced craftsmen who are proud of the equipment they build—and build it to last.

The next time you consider a drive for heavy, continuous-service equipment be sure to call in your G-E representative to discuss any special application problem you may have. Have him explain the many money-saving uses for G-E synchronous motors and point out their operating economies.

In the meantime, you can obtain more information on G-E synchronous motors by writing for these publications: GEA-5332, "Low-speed Synchronous Motors," or GEA-5426, "High-speed Synchronous Motors." Write to Section 770-29, General Electric Co., Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

GIVE LONG, DEPENDABLE SERVICE . . .

3. LONG INSULATION LIFE . . .

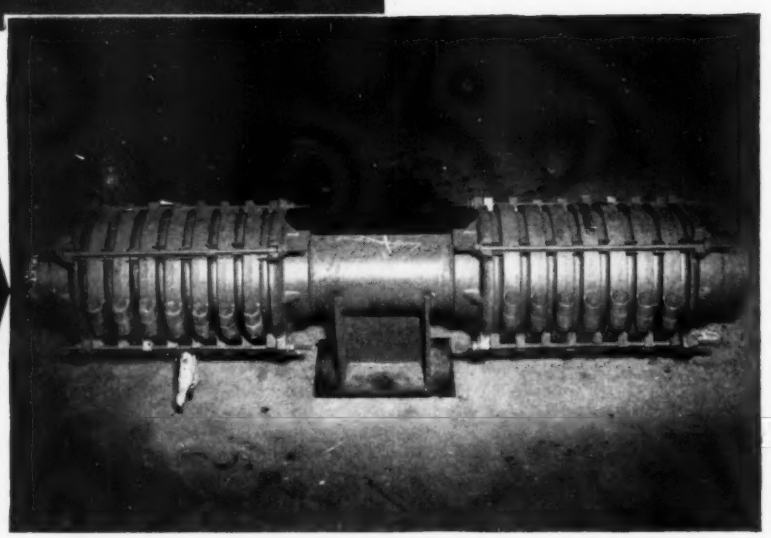
Insulating materials, manufactured in our own factories by the most modern methods, conform to rigid G-E specifications and are applied by experienced operators, above. Thus coils are uniform, interchangeable, mechanically rugged, and moisture resisting.

4. LOW-RESISTANCE CONNECTIONS . . .

For dependable operation, stator windings are silver brazed, as shown above. Joints of this type have low electrical resistance, exceptional thermal and mechanical strength. These important properties are difficult to obtain by other methods.

THIS STEAM LOSS WAS STOPPED FOR LIFE...

WHEN THIS FLEXON EXPANSION JOINT WAS INSTALLED



THREE TYPES AVAILABLE

FREE-FLEXING—*Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 30 psi, temperatures from minus 20° F. to 800° F.*

CONTROLLED-FLEXING — (Illustrated above) *Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 300 psi, temperatures from minus 20° F. to 800° F.*

FLEXONIFLEX—*Integral ring type. Available in sizes from ½" pipe through 6" pipe. Suitable for pressures to 5500 psi, temperatures from minus 400° F. to 1600° F.*

Steam loss through antiquated expansion joints in the shipyard where the upper photo was taken was calculated at over $17,500 per year before modern Flexon Expansion Joints were installed. Flexon Expansion Joints cannot leak . . . they are uni-metal assemblies which when properly installed become a part of the pipe. Unlike the joints which they replaced in this shipyard, Flexon Expansion Joints require no maintenance . . . there is no packing to take up or replace. Just install them and forget them.

If you're letting dollars escape through leaky, troublesome expansion joints, ask your Flexonics representative to show you how Flexon Expansion Joints can put an end to this problem, or write for the Flexon Expansion Joint Bulletin.

Flexonics *Corporation*

EXPANSION JOINT DIVISION
1301 S. THIRD AVENUE • MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

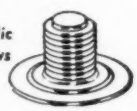
Flexon identifies products of Flexonics Corporation that have served industry for over 50 years.

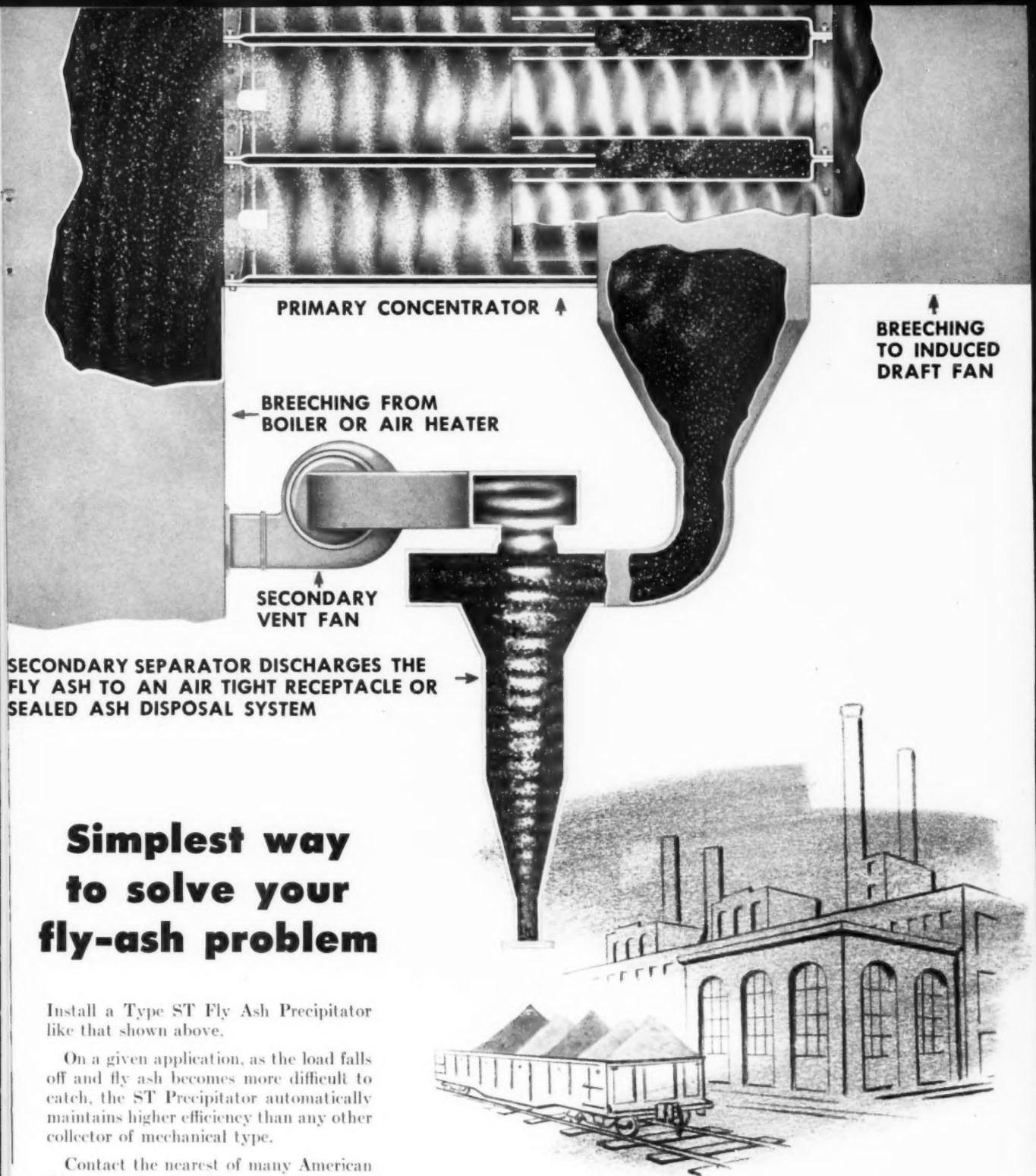
Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows




PRIMARY CONCENTRATOR
BREECHING TO INDUCED DRAFT FAN
BREECHING FROM BOILER OR AIR HEATER
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

Simplest way to solve your fly-ash problem

Install a Type ST Fly Ash Precipitator like that shown above.

On a given application, as the load falls off and fly ash becomes more difficult to catch, the ST Precipitator automatically maintains higher efficiency than any other collector of mechanical type.

Contact the nearest of many American Blower and Canadian Sirocco Branch Offices, strategically located throughout the United States and Canada, for complete information on Type ST Fly Ash Precipitators.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

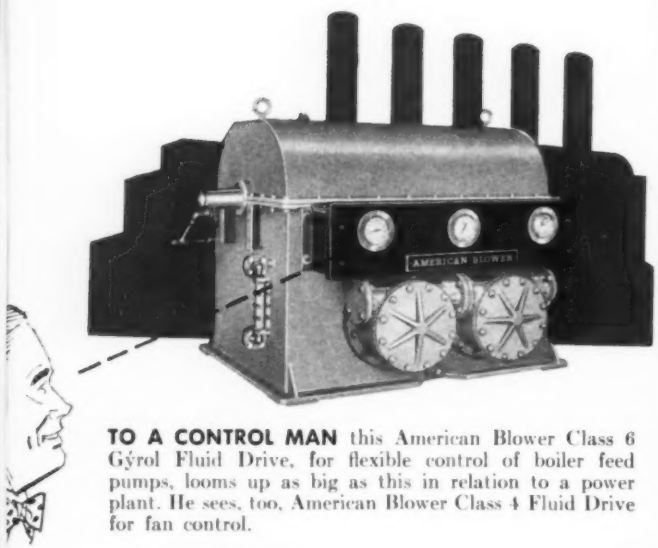
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

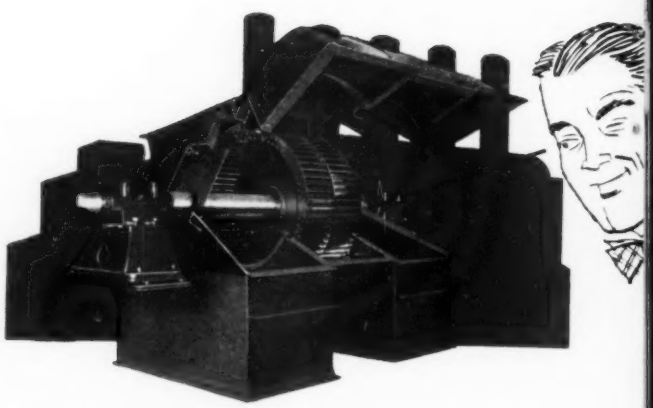
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS HEATER

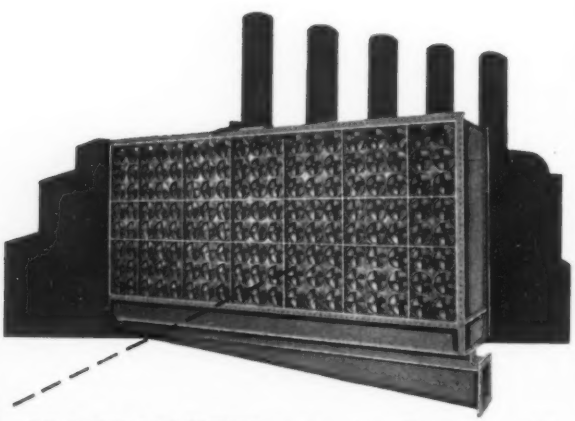
It all depends on how you look at it



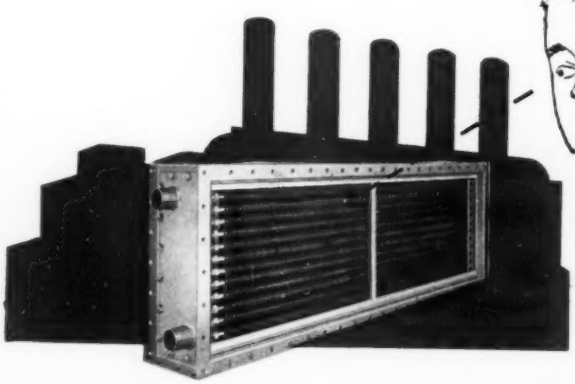
TO A CONTROL MAN this American Blower Class 6 Gyrol Fluid Drive, for flexible control of boiler feed pumps, looms up as big as this in relation to a power plant. He sees, too, American Blower Class 4 Fluid Drive for fan control.



TO A MECHANICAL DRAFT MAN a Sirocco Multi-Blade Fan, which delivers more gas per revolution than any other type, takes *this* proportion in the picture. He could see an American Blower HS Fan equally large if thinking of forced draft.



TO A FLY ASH EXPERT an American Blower Type ST Fly Ash Precipitator looks like this in relation to the rest of the power plant. Little wonder, for the Precipitator lifts a load off his shoulders and minimizes a nuisance.



TO A COIL MAN American Blower Heavy Duty Steam Coils would appear like this in his power plant picture. He likes their great strength, easy accessibility and the way they withstand the high pressures of heavy loads.

Looking at your complete power plant picture, we believe you'll find, as hundreds of others have, that all these American Blower Products improve over-all power-plant efficiency and insure years of dependable operation. Call our nearest Branch Office for complete data.

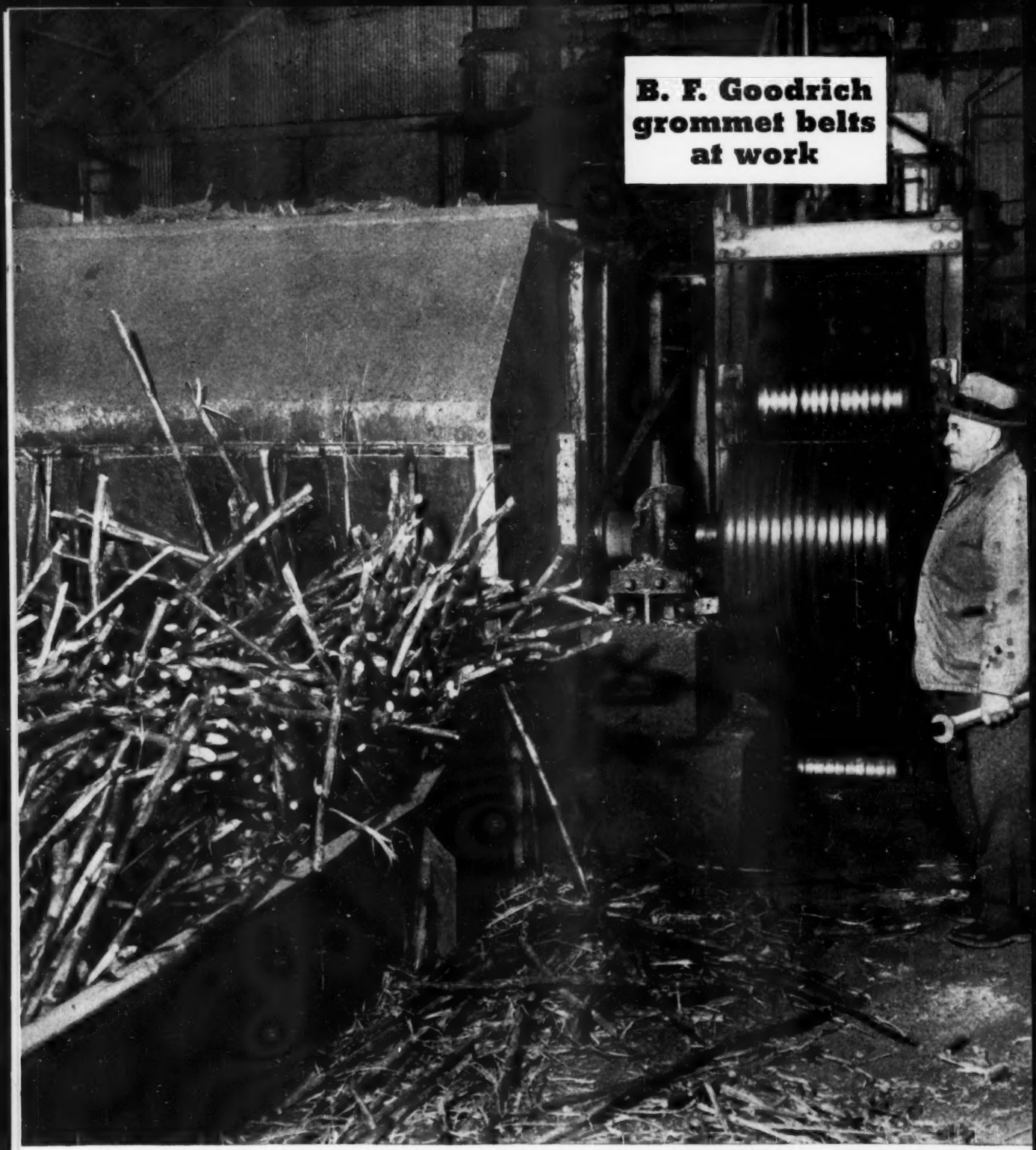
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE · DETROIT CONTROLS · KEWANEE BOILERS · ROSS HEATER



Every day is sweetest day at Godchaux Sugars, Inc., during grinding season when cane is shredded, then boiled into sugar.

Raising cane — for candy makers

After sugar cane is harvested, that shredding machine has to work 24 hours a day, 7 days a week, or a lot of cane can spoil. Old-fashioned belts, originally used to drive the machine, couldn't stand the high speed and sudden jerks as carloads of cane are dumped into the cutting knives. They averaged only two years' use. To find out how this problem was solved, see the following pages.

Raising Cane (continued)

Grommet V belts are so much stronger, knives on the shredding machine can now chew up 40 extra tons of cane each hour.

The problem described on the preceding page was solved when B. F. Goodrich V belts were put on the drive. They lasted nine years. Now B. F. Goodrich grommet V belts are being used—and the sugar company finds they are so much stronger that the knives can cut 100 tons an hour instead of 60 as they used to do. The grommet belt is a typical B. F. Goodrich improvement—an improvement that saves money, does jobs better for industries of all kinds.

Strongest V belt made

All the load-carrying cords in patented grommet belts are concentrated in twin grommets. These grommets are cord

loops made like giant twisted cables except that they're endless. Since there are no center cords, the grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. As a result, grommet belts last 20 to 50% longer, depending on the service. (The more severe the service, the greater the increase over ordinary belts.)

No weak spots

The section where cords overlap is the weak spot in ordinary belts. That's where 80% of V belt failures occur. But in grommet V belts this cause of belt failure has been eliminated. The grommets are endless. There are no splices or overlaps—no weak spots to cause premature belt failure.

⅓ more gripping power

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip sheaves better. Size for size, grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor. And because there is less slip, there is also less surface wear.

Less stretch

In ordinary belts under tension, the center cords loaf, the outer cords overwork because tension is greater near the driving faces. Grommet belts, with no center cords, have much more strength and less stretch. Grommet belts stretch, on an average, only about ⅓ as much as ordinary belts.

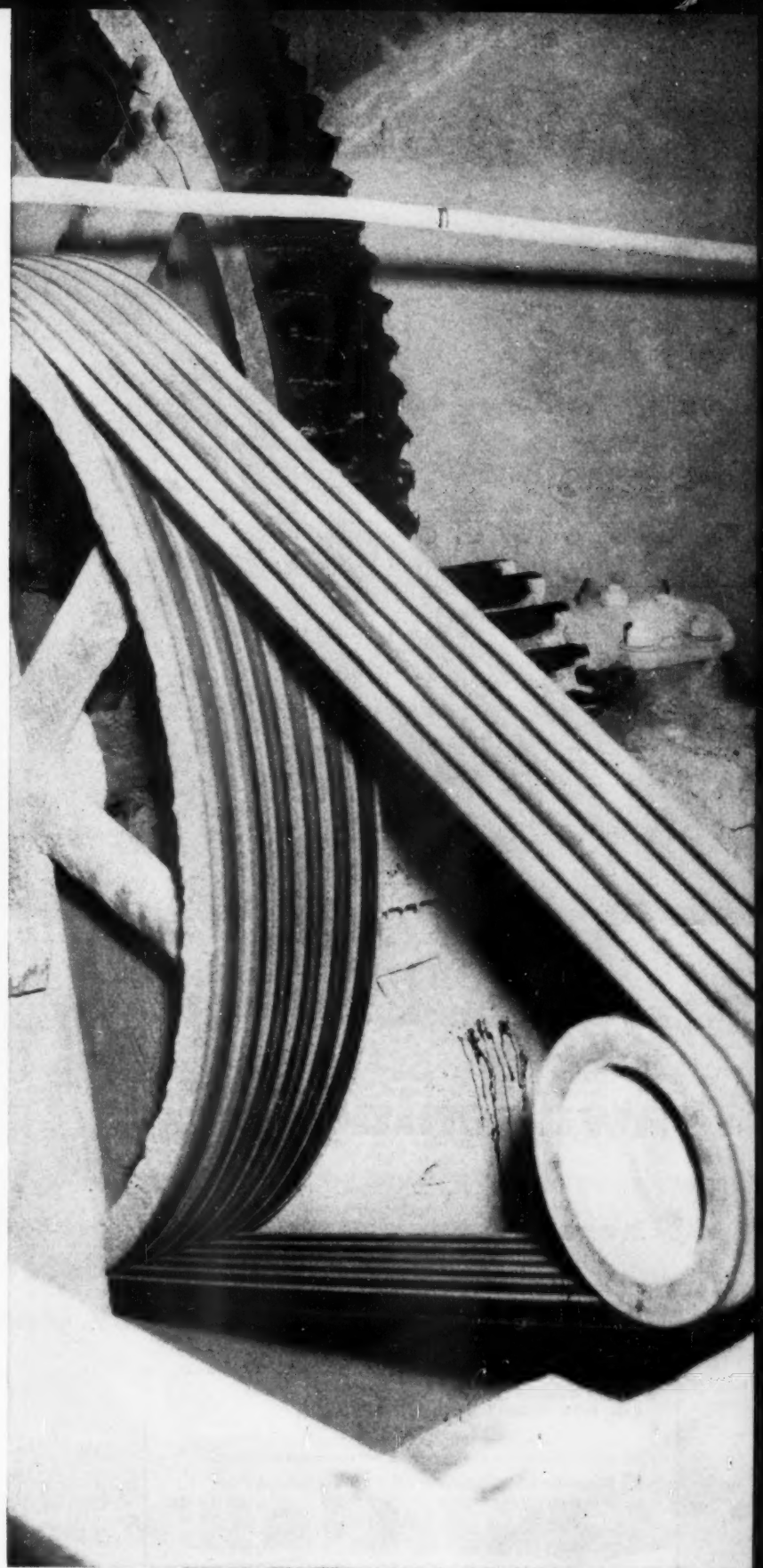
Save 3 ways

With grommet belts, you save on replacement costs because they last 20 to 50% longer. You save on production costs because machines keep running with fewer interruptions. And you save on maintenance costs because the V belts need less attention. Yet these savings they can make for you are all clear profit because grommet belts cost not one cent more than ordinary V belts.

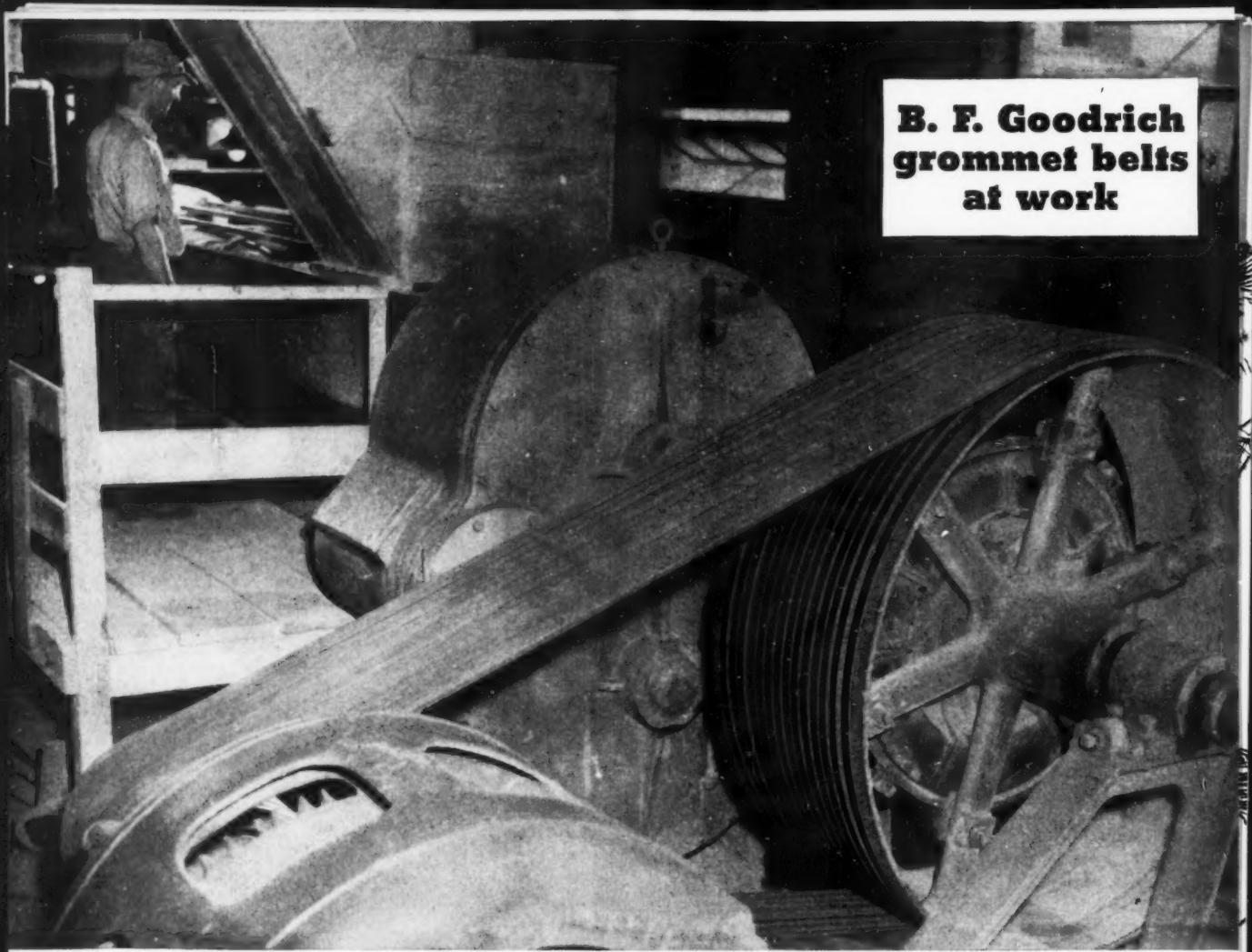
20 ton ball team ➤➤

These rubber belts turn a ball mill containing 20 tons of steel balls, water and ore that grind until the mineral can be separated. Six ordinary belts weren't enough. They were falling to pieces from overwork in only 5 or 6 weeks.

The job was too big for six ordinary belts and there wasn't space to expand. Then B. F. Goodrich grommet belts were tried. The first grommet belts lasted not six weeks but six months, saved $100 a month in belt costs, saved a probable $800 for redesigning and rebuilding the drive.



Belts turn 20 tons of steel balls, water and ore to grind powder for paints.



Belts whirl, clay is mixed and out of that machine come 16 million bricks each year.

Rude awakening

Each morning these belts take a beating when this fully-loaded, brick-making machine is first started. The shock, combined with the heavy pulling load and high speed, caused the first set of V belts used on this drive to fail in only six months. Something exceptional was needed, so B. F. Goodrich grommet V belts were installed. That was over four years ago, and they're still in use. In fact, the company superintendent says it looks as though this original set of grommet V belts will operate another ten years.

These typical examples (see preceding pages) tell you why B. F. Goodrich grommet belts are superior to ordinary V belts—prove they last 20 to 50% longer—yet cost no more.

The B. F. Goodrich Company
Dept. M-75, Akron 18, Ohio

☐ Send set of reports telling users' experiences and showing actual installations where grommet belts outlasted all others.

☐ Please have a BFG distributor call. I'd like to find how I can save money with grommet V belts.

Name_____

Firm Name_____

Address_____

_____

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

Low Cost *Installation*

FACTORY PACKAGED RECTIFIER UNITS CUT INSTALLATION TIME AND COSTS

The factory packaged design of Allis-Chalmers sealed tube mercury arc rectifiers cuts labor time and costs. All component parts are metal-enclosed and integrally connected into one complete unit. This unit can be located convenient to your dc load center to cut dc feeder cost and reduce dc distribution loss . . . requires no special concrete foundation. And because of its light weight, it can be installed on a balcony or elsewhere to conserve valuable floor space. Only connection to power and control leads and to cooling water supply is necessary to make unit ready for service.

Allis-Chalmers sealed tube rectifiers are offered in ratings from 200 kw at 250 volts to 1000 kw at 600 volts.

When you are planning a new dc power installation of *any* size, it will pay you to investigate the many cost cutting features of the Allis-Chalmers rectifiers. For complete details, call your nearest A-C sales office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4144

MERCURY ARC RECTIFIERS

This 500 kw Allis-Chalmers factory packaged mercury arc rectifier unit is installed at a large Wisconsin plumbing fixture manufacturer. From left to right, the unit consists of dc feeder and cathode breaker compartments, rectifier tube compartment, rectifier transformer, and 12.5 kv ac switchgear compartments. Since its installation, this unit has greatly reduced costs of dc electric service to cranes, material handling equipment and machine tools.

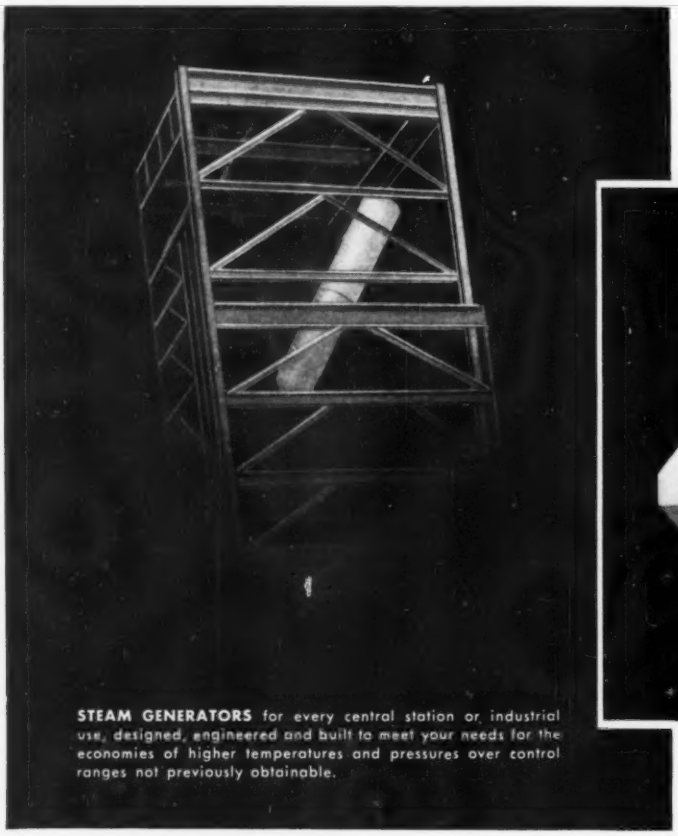
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

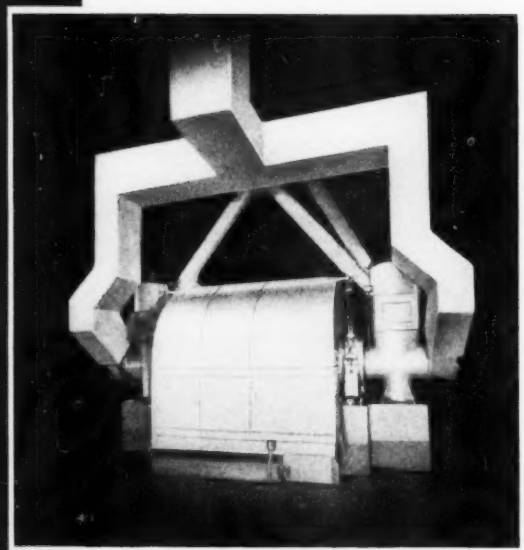
Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

One source

... meets



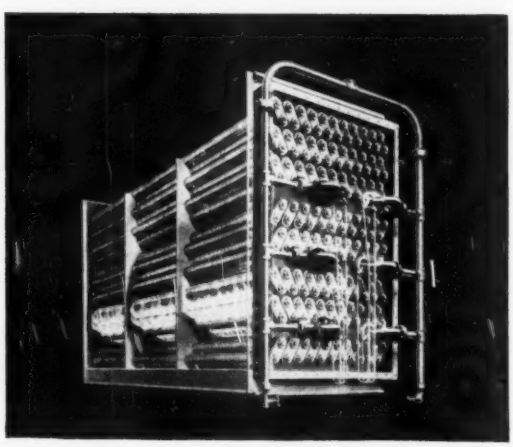
STEAM GENERATORS for every central station or industrial use, designed, engineered and built to meet your needs for the economies of higher temperatures and pressures over control ranges not previously obtainable.

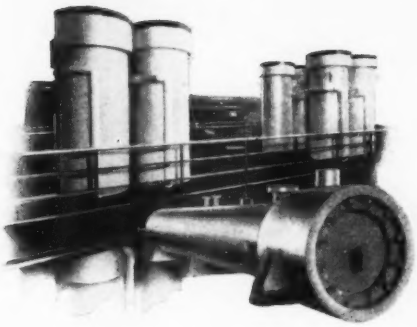


BALL MILL PULVERIZERS which grind hard, abrasive fuels to a constant fineness. Operating records show low maintenance, high availability of 99% or better.

SUPERHEATERS of the convection and radiant type, either singly or in combination. Superheat control over a wide load range is also offered as a means of positive and accurate control of final temperature.

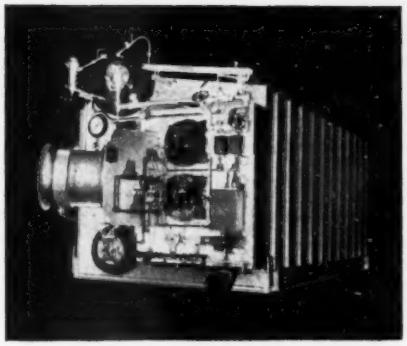
ECONOMIZERS of the cast-iron, extended-surface steel-tube type which are corrosion-resistant, impervious to soot fires, easily cleaned, and of unique, simple design. Bare tube construction also available.





PACKAGE STEAM GENERATORS in capacities of 10,000 to 30,000 lb. of steam per hr. Water-tube type, plant assembled, shipped ready to install. Design pressures of 250, 525, 825 psig provide operating pressures from 100 to 800 psig.

FEEDWATER HEATERS of the shell-and-tube type, as well as direct contact arrangements, are available. "Lockhead" closures have been built for pressures up to 3500 psi.

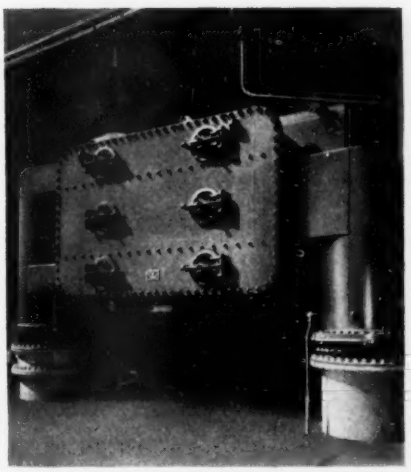


many of your steam plant needs

Only Foster Wheeler offers such a broad line of steam plant equipment engineered for increased efficiency through modernizatior

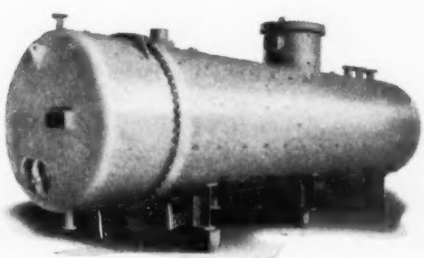
IN OVER 50 YEARS of service to the power industry, Foster Wheeler has pioneered the development of steam generators, fuel systems, condensers and cooling systems of the highest efficiency. Continuous research and engineering have created a background of technical experience, *as well as* an integrated line of equipment in which each individual product is designed to contribute to the efficiency of all.

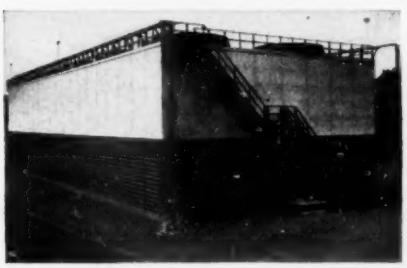
FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



CONDENSERS to meet any conditions of headroom at any location. Our shops are fully equipped to supply units of 100,000 sq. ft. and larger.

EVAPORATORS for boiler feed make-up and of heat-transformer types in all sizes. Special types to handle raw and treated make-up to give the best thermal and descaling operation as well as producing pure vapor.

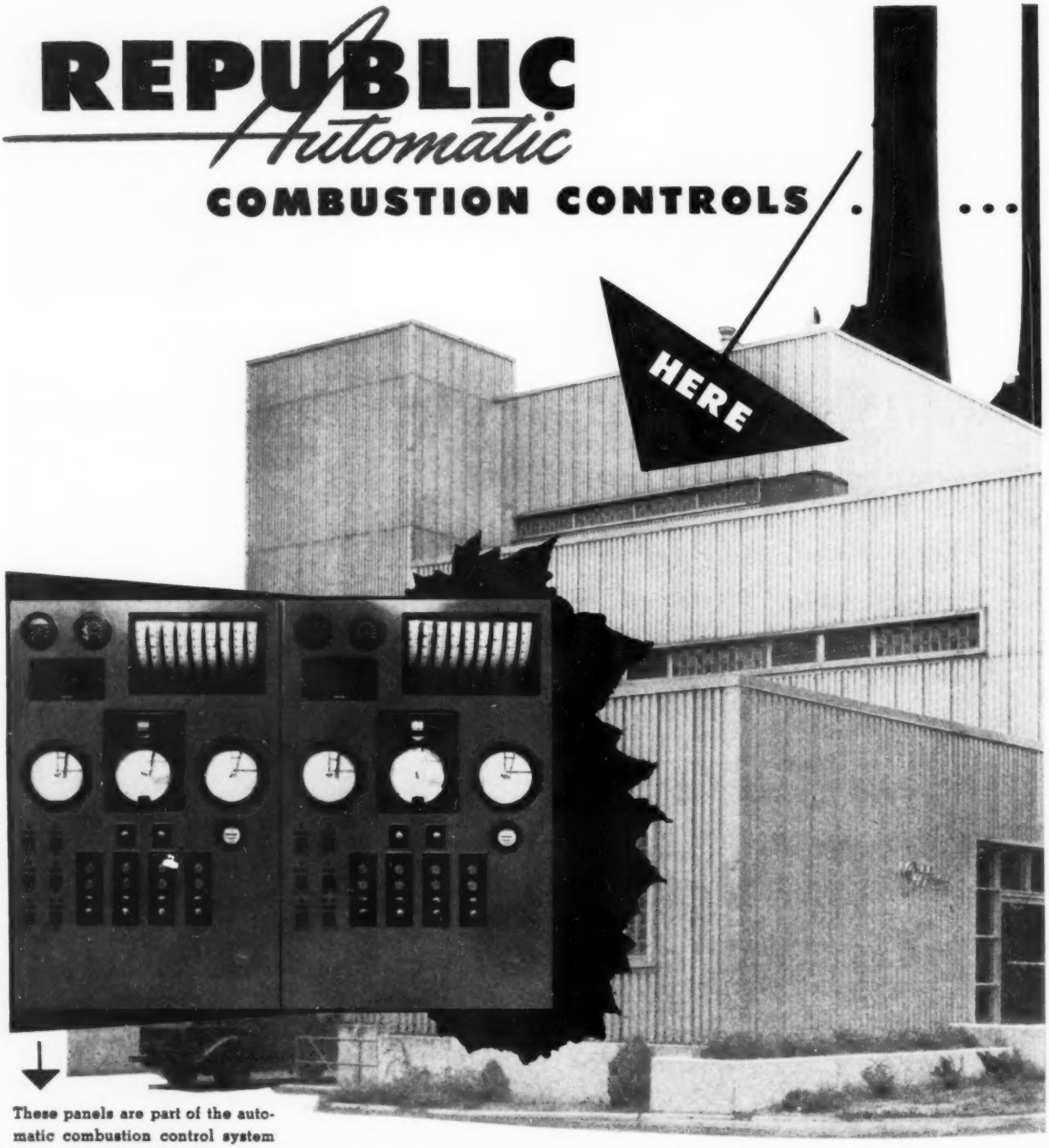




COOLING TOWERS custom-engineered to meet your requirements for greatest economy. Mechanical draft, counter-flow type. Provide minimum spray loss, flexibility to meet all weather conditions.

FOSTER WHEELER

REPUBLIC *Automatic*
COMBUSTION CONTROLS . . .



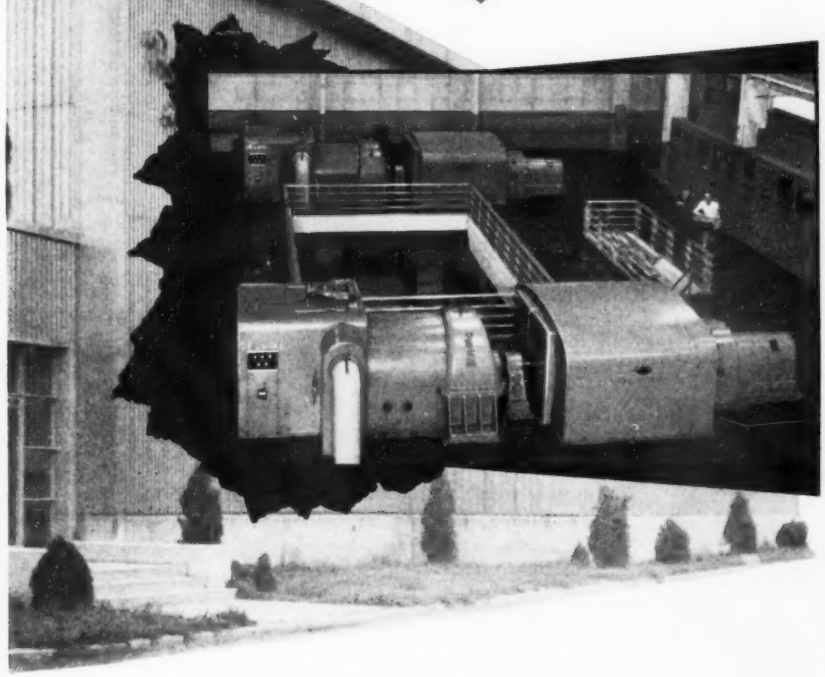
These panels are part of the automatic combustion control system for two 60,000 lbs/hr. spreader stoker fired boilers which supply steam to turbines at 600 psig and 825° F. Manual-automatic sub-panels and biasing sub-panels on the lower part of the control board provide for manual operation of the entire combustion system from this central point.

For all Types and Sizes of Boilers

Regardless of the type of fuel, size of boiler, draft arrangement or load characteristics, Republic Combustion Controls can operate boilers to hold fuel and air in the correct amounts and proportion for maximum efficiency.

WRITE FOR FULL INFORMATION
NO OBLIGATION

. GIVE MORE POWER AT LESS COST HERE



At the Henderson, Kentucky Municipal Power Plant,

turbine generators each have a capacity of 5,000 kw. With Republic Automatic Combustion Controls, steam demand at the turbines is *automatically* matched by steam available from the boilers.

INCREASED STEAM OUTPUT

Boilers are operated at test efficiency 24 hours a day, 7 days a week.

LOWER FUEL COST

Fuel is burned at maximum combustion efficiency for more BTU's per dollar of fuel used.

LOWER MAINTENANCE COST

Operating conditions are held uniform, preventing chain-of-event troubles that frequently result from incorrect boiler operation. Ruggedly built, Republic Controls give years of dependable service.

FULL BOILER RATING WHEN NEEDED

When peak loads occur, boilers can deliver all of the steam they are rated for. Boiler capacity over the plant rating is not necessary to meet "peaks".

these Advantages can be Yours with

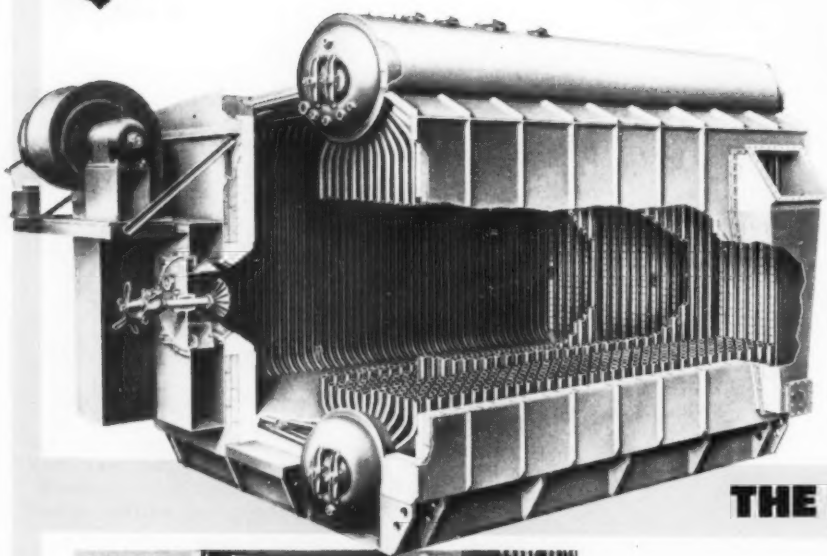
REPUBLIC COMBUSTION CONTROLS

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

FOR STEAM CAPACITY
choose your boiler

Whatever your fuel . . . whatever your steam capacity requirements up to 60,000 pounds per hour — you'll find one of the C-E Boilers shown here will be just right for you.

If you burn oil or gas, investigate the VP Pack-



Specifications — VP Boiler

Capacity — 4,000 to 30,000 pounds of steam per hour

Pressures — Up to 250 pounds per square inch

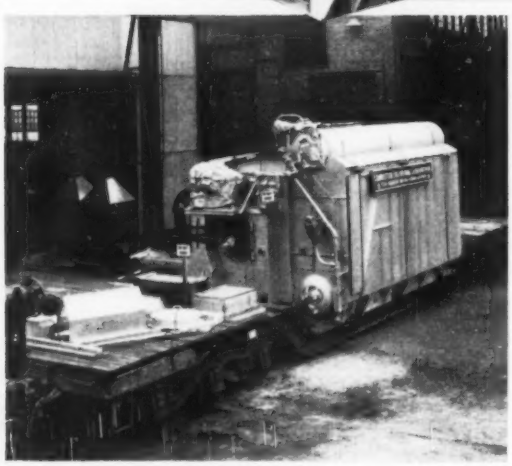
Temperature — No superheat

Fuel — Oil or gas

Erection — Completely shop-assembled

Foundation — Simple concrete slab

THE VP BOILER



The C-E Package Boiler, Type VP . . . completely shop-assembled . . . for oil or gas firing. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large (30-in. diameter) lower drum permits a simple, symmetrical, tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. The centrifugal fan is efficient, yet its noise level is less than half that of typical high-speed blowers used on most package boilers. Baffle arrangement is simple, resulting in low draft loss . . . simple soot blowing . . . elimination of dead pockets . . . high heat absorption. Write for Catalog VP.

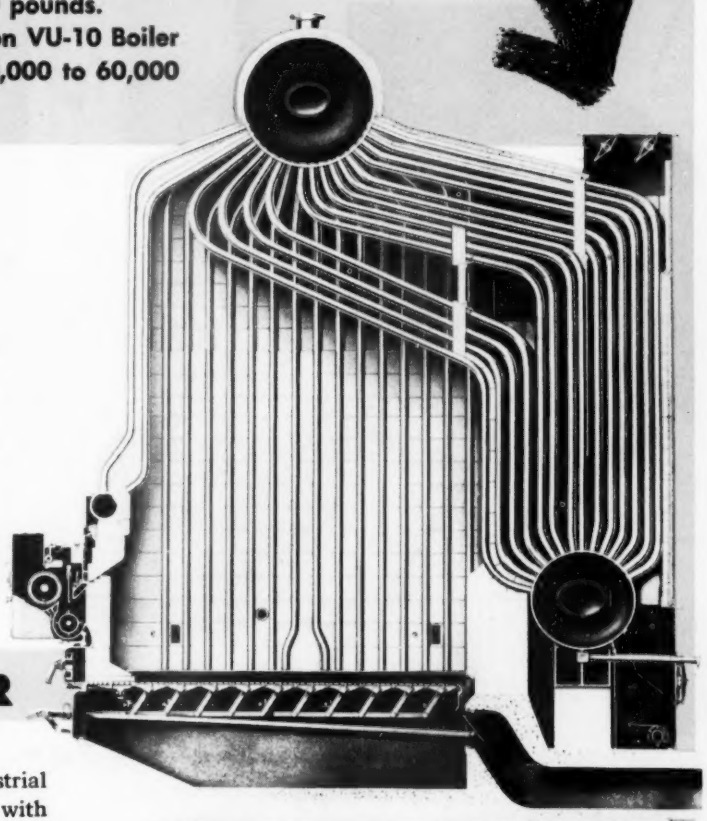
COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

UP TO 60,000 POUNDS *from these two*

age Boiler for capacities up to 30,000 pounds per hour . . . the VU-10 up to 60,000 pounds.

For stoker firing, the Combustion VU-10 Boiler is available in capacities from 10,000 to 60,000 pounds of steam per hour.



Specifications — VU-10 Boiler

Capacity — 10,000 to 60,000 pounds of steam per hour

Pressures — Up to 475 psi

Temperatures — Superheat available if desired

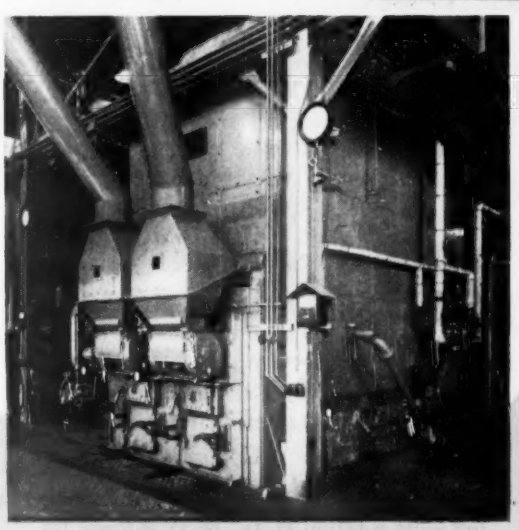
Heat Recovery — Economizers, air heaters available if desired

Fuel — Coal (C-E Spreader, Traveling Grate or Underfeed Stoker); oil or gas.

Erection — Field erected

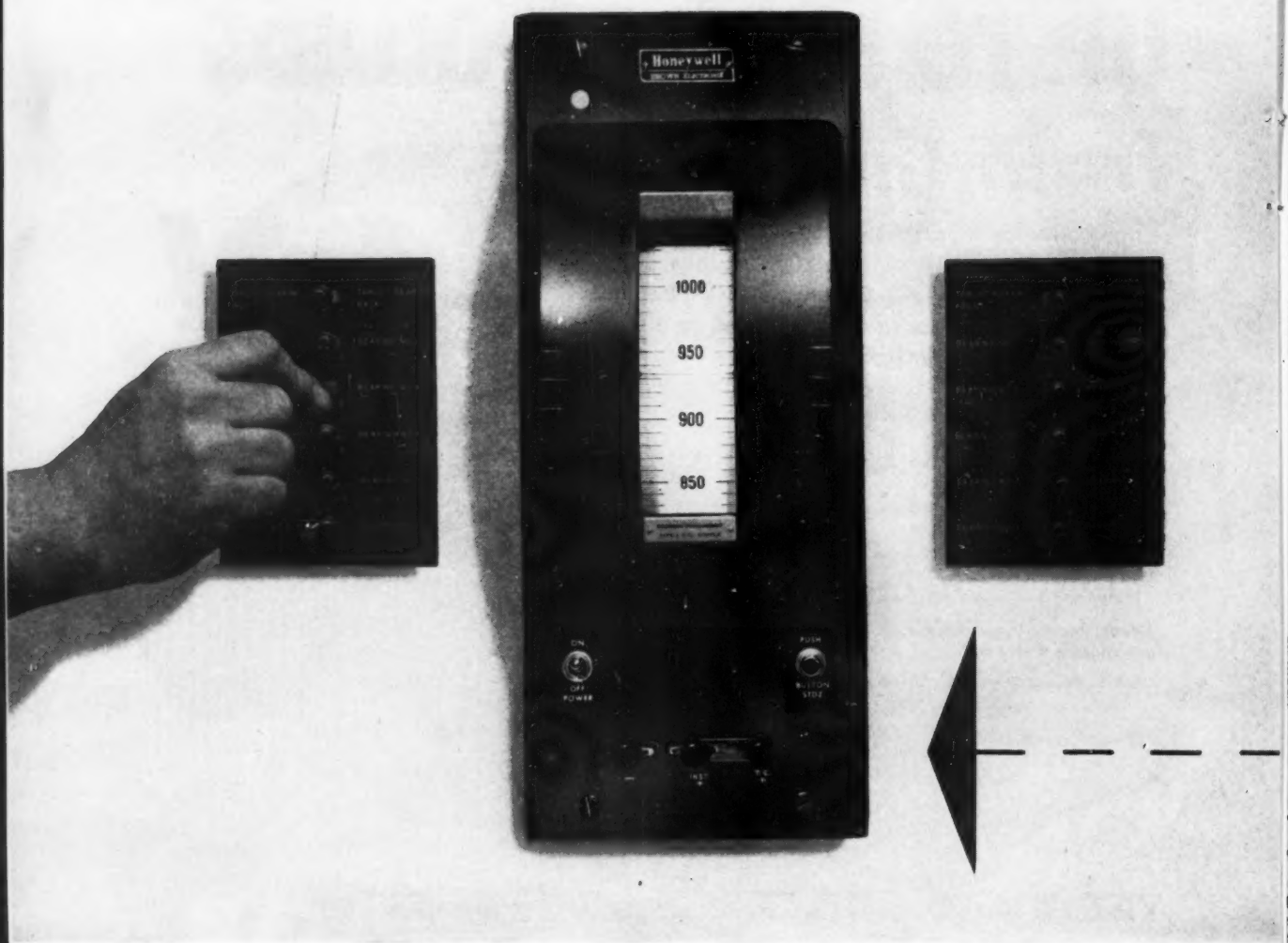
THE VU-10 BOILER

The VU-10 Boiler is designed for industrial load conditions, particularly for plants with small operating and maintenance forces. Fuel can be either coal, oil or gas. This boiler is a completely standardized design adaptable to many conditions. It responds readily to variations in load; it is simple to operate and maintain. All parts are easily accessible for inspection. Like the VP, the VU-10 Boiler is a complete unit — boiler, furnace setting, fuel-burning equipment, controls, forced draft — bringing you the benefit of one contract . . . one guarantee . . . one responsibility. Write for Catalog VU. 10-8. B-689



C-E

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT



Look at these features!

compact case
approximately 6½ inches wide by 15⅜ inches high

easily-read drum scale
rotates vertically; graduated length 28⅝ inches provides big, legible scale divisions and numerals.

accurate hairline index
eliminates parallax errors, permits high readability.

fast measurement
full scale rotation in 4½ or 12 seconds for 60-cycle operation.

external key switches
can be located at the side of the indicator (as shown), below or above—wherever most convenient for the particular panel layout.

large number of points
additional key switch banks provide any desired number of temperature points. Legend plates facilitate identification.

high precision
calibrated accuracy is 0.2% of scale span.

variety of ranges
supplied for use with either thermocouples or resistance thermometers, in a selection of ranges applicable to power plant temperatures.

Squeezed for panel space?

THIS NEW

Honeywell temperature indicator

needs no elbow room!

CROWDED PANELS are no problem for this new temperature instrument . . . the Vertical Scale Precision Indicator. Its slender, compact case makes it a natural for graphic panels—and a readily-inserted, space-saving member of conventional generator and turbine boards.

Basically, it's the same *ElectroniK* Precision Indicator which the power industry and many others have used and relied upon for many years. But, its outside appearance has changed: it's a completely new design that places the bulk of the instrument mechanism *behind* the panel . . . uses the valuable front-of-panel space primarily for the indicating scale.

Equipped with key switch banks, the Vertical Scale Precision Indicator offers a fast, convenient way to spot-check temperatures in bearings, pumps, hydraulic couplings, motors and other potential hot spots.

Your local Honeywell engineering representative will be glad to discuss how this new instrument can save space on the new panels which you may be planning. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin No. 1541 on the Vertical Scale Precision Indicator.**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

ECONOMICAL answers to industrial problems—a few of which are shown on these pages—call for specialized *facilities* and years of *experience*.

Here at Alco you will find a large measure of both. You will find experience gained through many years of designing and fabricating heavy metal equipment for petroleum, chemical, power and manufacturing companies all over the world.

You will find modern equipment and machines, many of them designed and built by Alco, capable of meeting almost every conceivable type of metal-fabricating requirement—facilities operated by skilled craftsmen, and applied by designers and engineers fully aware of industry's needs.

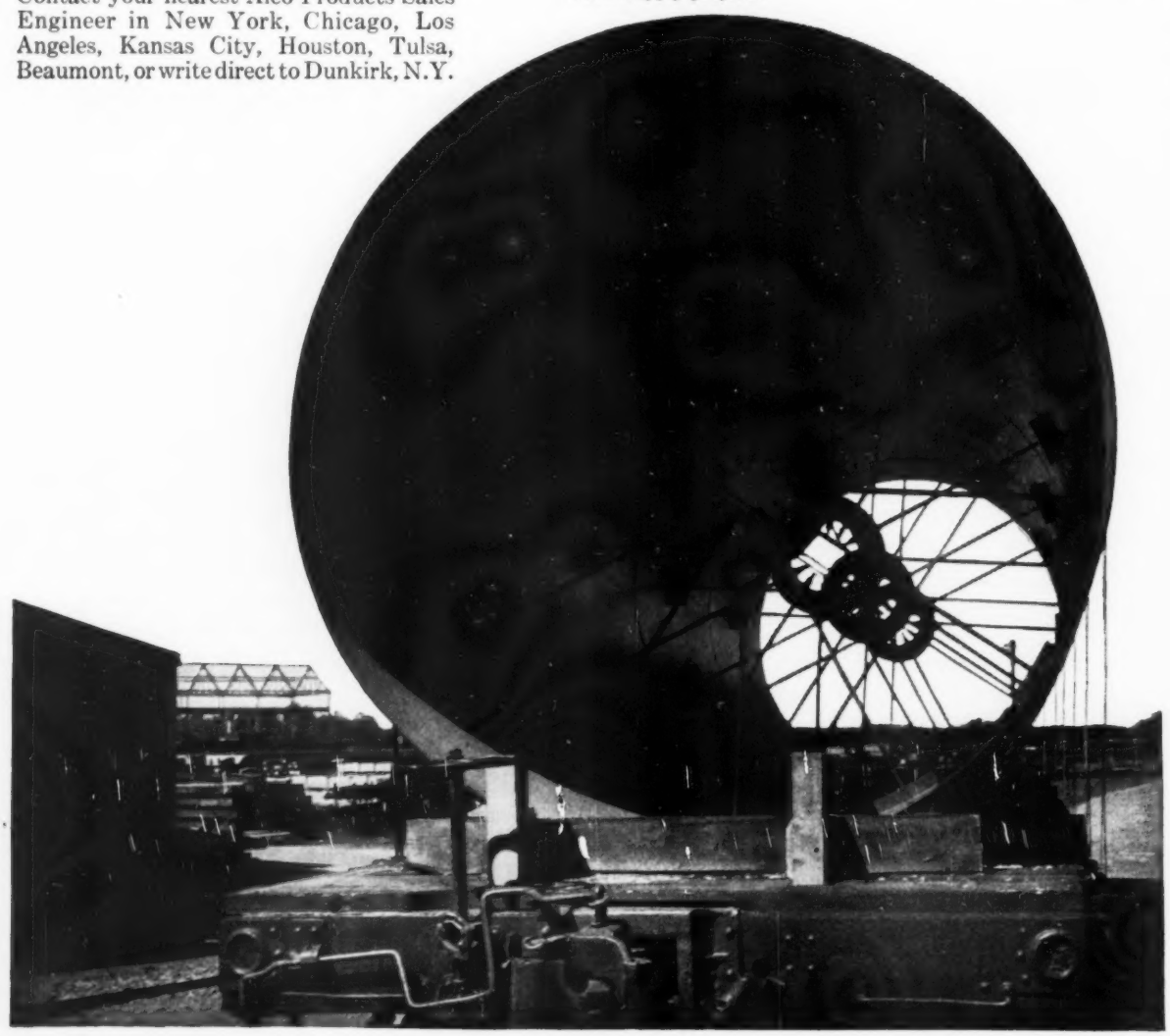
If you have a difficult metal-fabricating problem—a problem that challenges the imagination, that points to new equipment or offers new opportunities to cut production costs—we invite you to let Alco's facilities and experience produce the answer.

Contact your nearest Alco Products Sales Engineer in New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, Beaumont, or write direct to Dunkirk, N.Y.

ALCO facilities

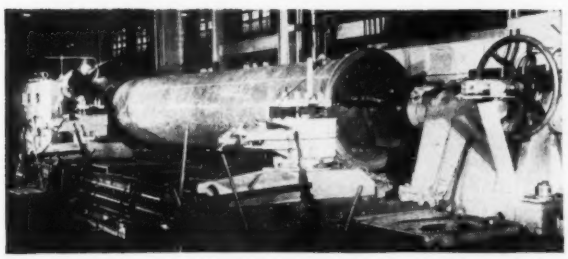
Answers to

TUNNEL INTERLININGS furnished by Alco in cold-rolled, carbon-silicon steel sections 40 ft long and 10 ft 6 in. in diameter will reinforce the outlet end of New York City's new $44,000,000 deep-rock East Delaware Water Supply Tunnel. Held to close dimensional limits, electric fusion welded throughout, they are the latest of many special piping sections fabricated over the years by Alco for New York water supply projects.

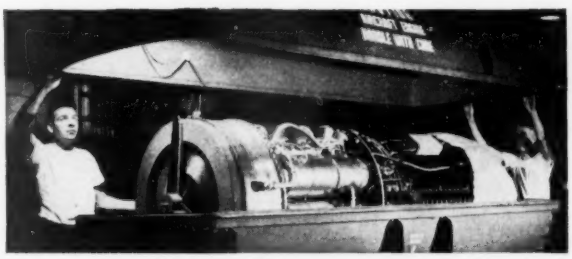


and experience produce...

New Industrial Problems



GIANT LATHE at Alco's 31-acre Dunkirk plant finishes and faces both flanges simultaneously on steel pipe up to 41 in. in diameter! Special machines like this, many of them Alco designed and all guided by the skilled hands of veteran craftsmen, help Alco solve the toughest of metal-fabricating problems.

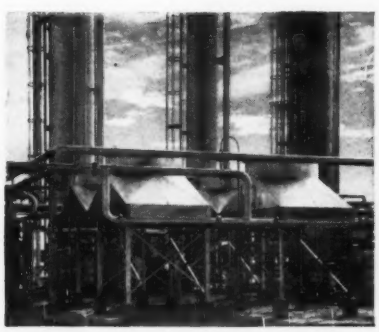


STEEL "CANS" FOR JET ENGINES, mass-produced by Alco, are carefully engineered to meet strict Air Force specifications. Example: they must "provide a barrier against the entry of water, dust, air and moisture *without* the aid of separately applied sealing compounds or materials."

ALCO

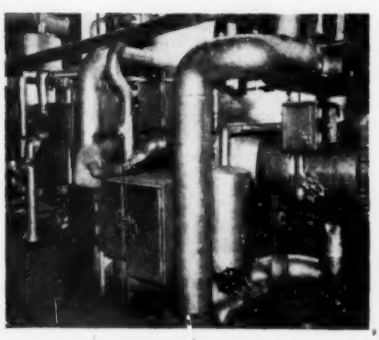
ALCO PRODUCTS DIVISION

AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK



"UNI-BUNDLE UNITS," with their specially fabricated steel headers, demonstrate the versatility of Alco Aircoolers. Vertical partitions welded in the headers allow several different vapor or liquid streams to be handled in a single tube-bundle. Here, for example, at a large Southwestern natural gasoline plant, the Alco Aircooler at right not only cools the oil but also condenses the overhead vapor from the stream.

"TRAIN" HEAT EXCHANGERS, designed and built of nickel steel by Alco for the Tennessee Gas Transmission Company's new gas processing plant (the world's largest) at Gabe, Kentucky, helped cut both installation and operating costs. Their flange-to-flange construction minimized the amount of connecting piping required, while their huge size (42 in. in diameter, 150 ft long) assured maximum processing efficiency.

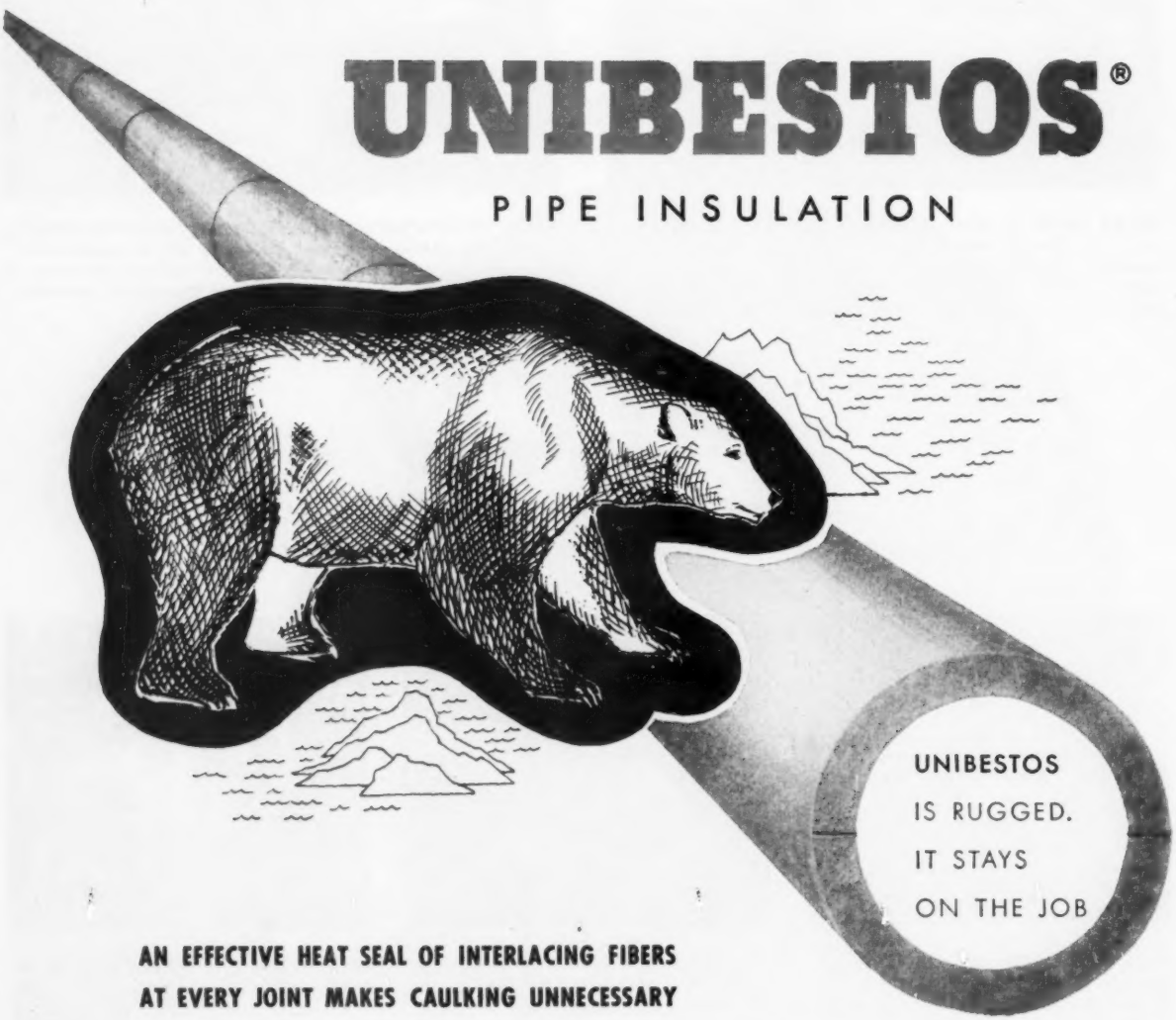


SPECIAL ALCO FLEX-TUBE EVAPORATORS at the Carolina Power and Light Company's new 150,000-kw plant at Goldsboro, N. C., produce vapor containing not more than 0.5 parts per million of mineral solids, hold make-up to less than one-half of one per cent. With its patented Flex-Tube construction, this Alco evaporator offers industry a positive-acting thermo-mechanical descaling device for straight-tube installation.

Lower heat-loss from single-layer applications

UNIBESTOS®

PIPE INSULATION

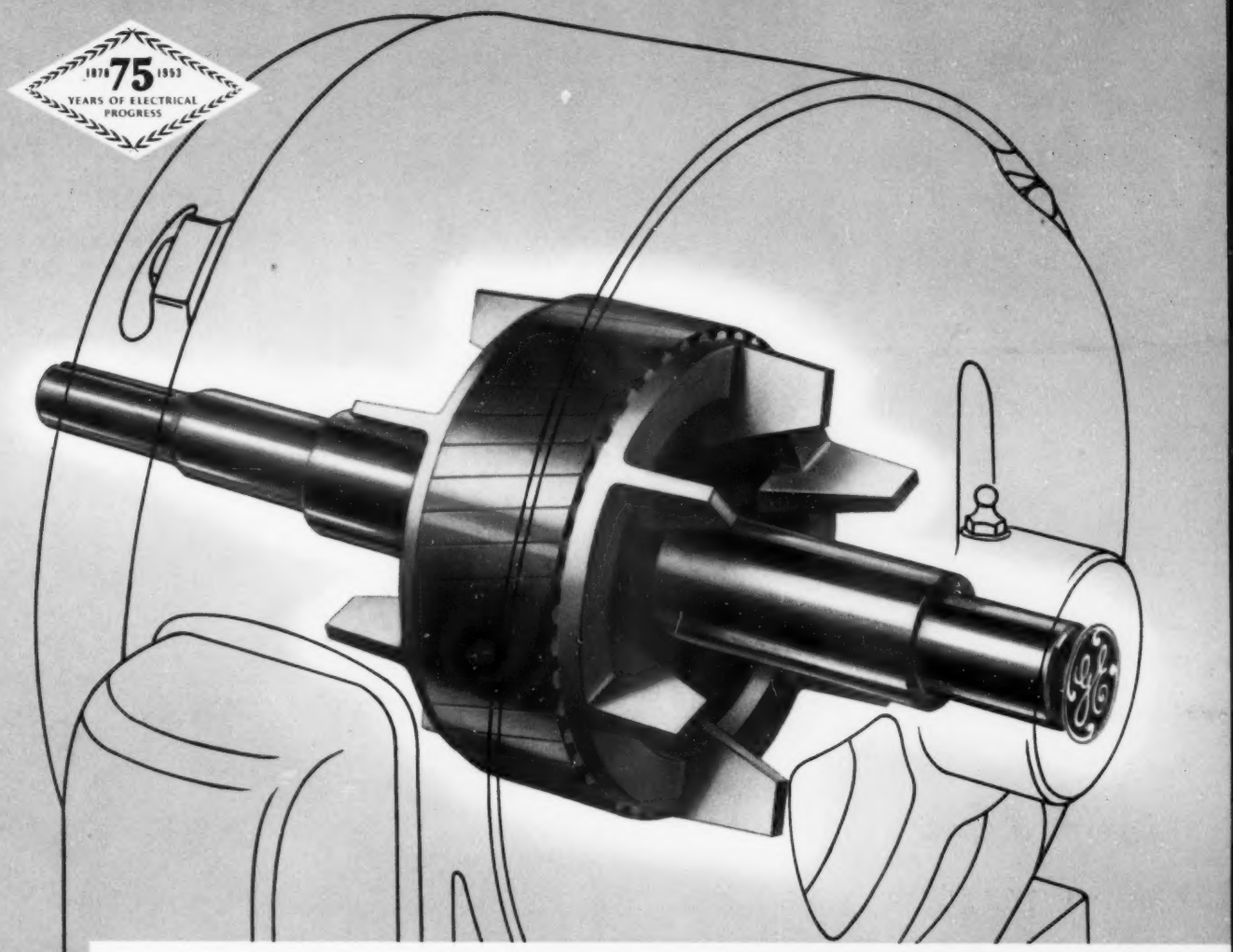


AN EFFECTIVE HEAT SEAL OF INTERLACING FIBERS AT EVERY JOINT MAKES CAULKING UNNECESSARY

UNARCO **UNION ASBESTOS & RUBBER COMPANY**

DEPT. C-9, 332 SOUTH MICHIGAN AVENUE, CHICAGO 4, ILLINOIS

1876 75 1953
YEARS OF ELECTRICAL PROGRESS



Why rotors don't fail in G-E TRI-CLAD motors

REG. U.S. PAT. OFF.

G-E pioneering and research developed and produced this one piece cast-aluminum rotor winding, which has virtually eliminated rotor failures in Tri-Clad motors.

Rotor is indestructible in service because the bars, end rings, and fans are a "one-piece" casting. No brazed joints, no fabricated fans to come apart.

Rotor inertia is reduced by the lightness of the aluminum, thus raising efficiency and allowing easier starting, stopping and reversing.

Rotor efficiency is higher, operating losses reduced, as the result of a special chemical treatment.

The motor runs cooler because the integrally cast fans dissipate heat faster.

Operation is smooth and quiet due to the dynamic balancing of the rotor which also reduces bearing wear and material fatigue.

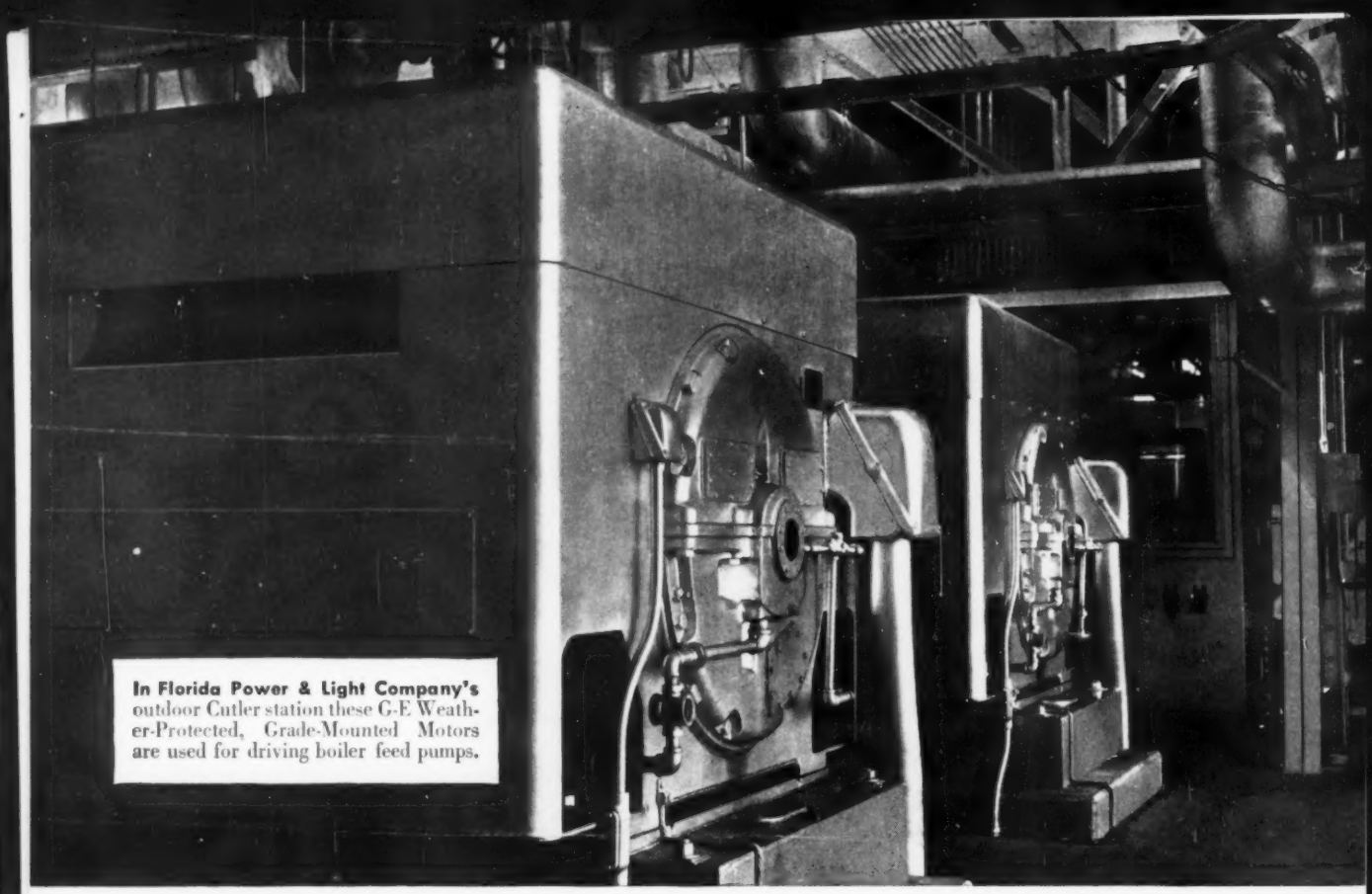
Long rotor life is one more reason why G-E Tri-Clad motors last longer — give you more reliable service and greater operating economy.

Order Tri-Clad motors today from your nearby G-E representative. You'll find popular models in stock. General Electric Co., Schenectady 5, N. Y.

752-20

You can put your confidence in—

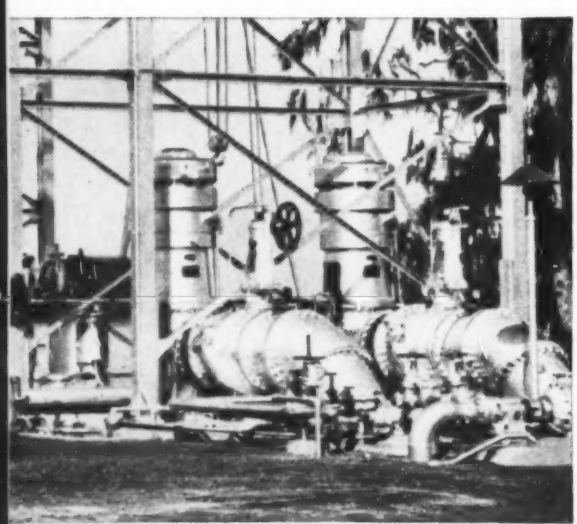
GENERAL ELECTRIC



In Florida Power & Light Company's outdoor Cutler station these G-E Weather-Protected, Grade-Mounted Motors are used for driving boiler feed pumps.

Designed specifically for outdoor, all-weather applications . . .

G-E Weather-protected Motors Provide Vital Continuous Service



G-E Weather-Protected Vertical Motors coupled to circulating water pumps operate outdoors in all weather at Florida Power & Light Company's Palatka Station.

Here's a low cost motor that the weather can't stop. For vital outdoor power station service, you can always count on reliable performance from rugged G-E Weather-Protected Motors . . . in all kinds of weather. An extremely effective ventilating system minimizes entrance of rain, snow, sleet and other airborne particles. Windings and other internal parts stay dry . . . assure you of dependable, all-weather service at minimum installed cost.

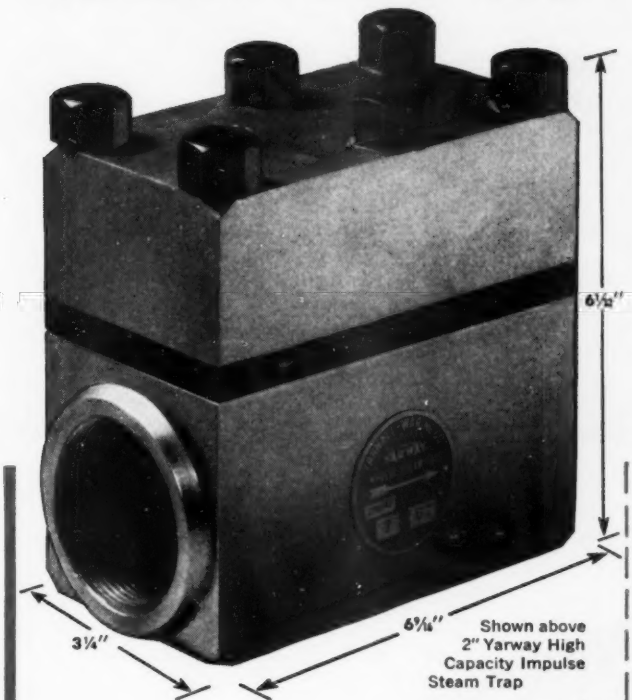
You get another big plus from industry's first successful outdoor weather-protected motor . . . the long-life quality developed in building over 2½ million horsepower of motors for power stations.

For complete information on these and many other features, contact your nearest G-E Apparatus Sales Office or write for Bulletin GEA-5810. General Electric Co., Section 753-5, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

NEW HIGH CAPACITY
IMPULSE STEAM TRAP



Shown above 2" Yarway High Capacity Impulse Steam Trap

CAPACITIES OF YARWAY SERIES 50 TRAPS

Pressure PSIG	CAPACITY* pounds per hour		
	1½"	2"	2½"
1	3000	4670	9500
2	4500	7000	15000
3	6000	9350	19500
4	7000	10900	22400
5	7500	11700	24400
6	8000	12500	26000
7	8300	12900	27300
8	8600	13400	28400
9	8800	13700	29400
10	9000	14000	30250
15	9650	15050	32800
20	10300	16100	35000
40	12530	19600	43500
60	14400	22500	49600
80	16000	25000	55000
100	17300	27000	60000
125	18700	29200	65700
150	19900	31100	70300
200	21900	34200	77400
250**	23500	36200	81500
300**	24700	37400	84000

*Capacities are based on condensate 30° F. below steam temperature.

**When total equivalent length of piping connected to trap is greater than 20 feet, it is recommended that the capacity values indicated for 200 # pressure be used in figuring requirements for all pressures above 200 psi.

NEED to handle condensate in unusually large quantities?

Then here is your steam trap—the Yarway Series 50 Impulse—"big brother" to the well-known Series 60 and 120 Yarway Impulse Steam Traps of which over 900,000 have been sold. Uses the same basic operating principle.

The new Series 50 (made in three sizes, 1½", 2" and 2½"), has proved highly successful for condensate drainage on heat exchangers and stage heaters in power plants; reboilers, reheaters, stills, evaporators, debutanizers, etc., in refineries and chemical plants; large dryers in paper mills and textile plants, etc.

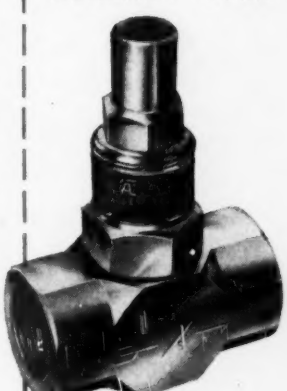
In many cases, Yarway Series 50 Traps have replaced traps several times their size.

For full information, write for Yarway Bulletin T-1745.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY
IMPULSE
STEAM TRAP

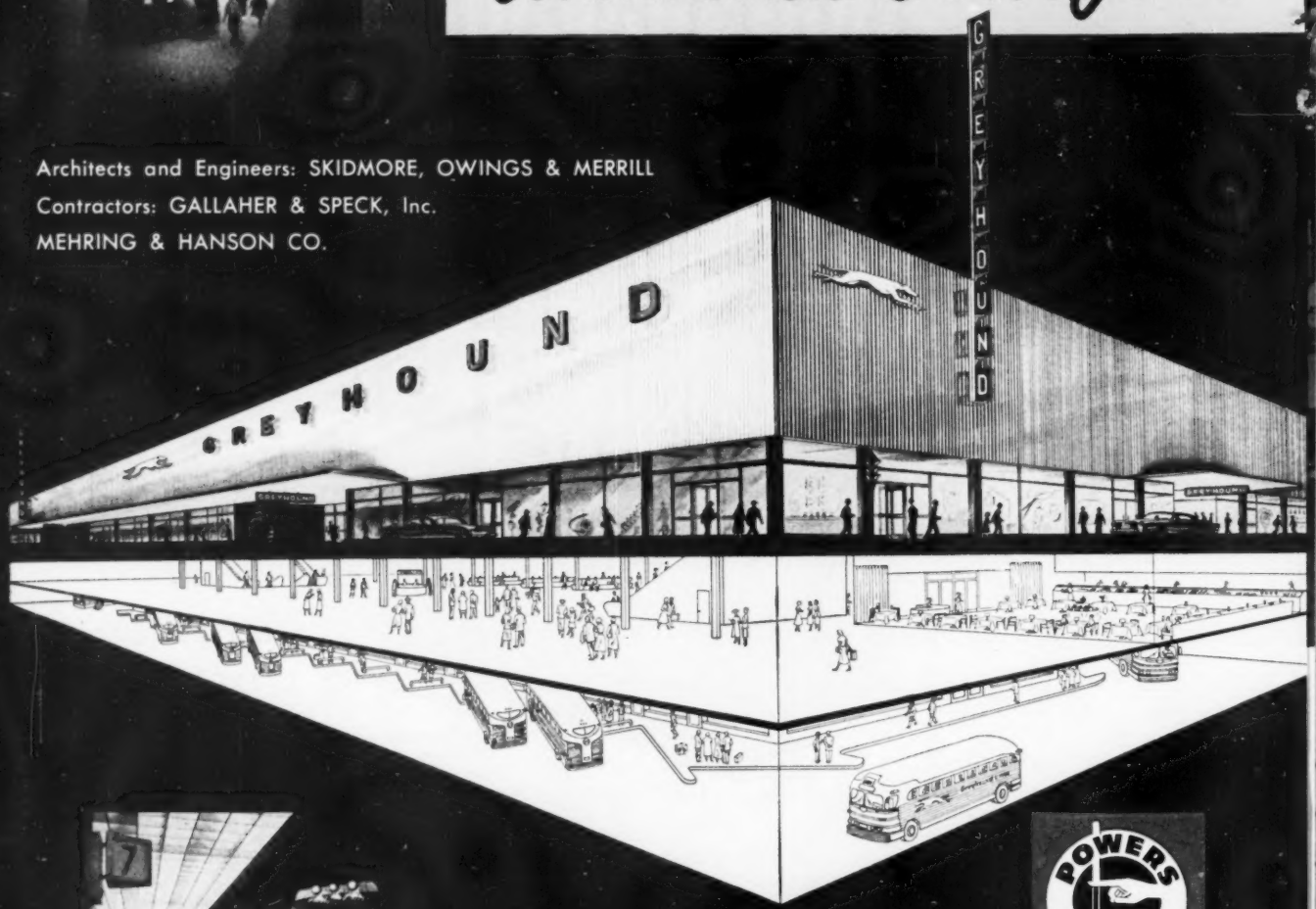
OVER 900,000 STANDARD YARWAY IMPULSE STEAM TRAPS ALREADY SOLD



Series 60 and 120 Yarway Impulse Steam Traps in six sizes from ½" to 2" are used for all normal requirements. Stocked and sold by 250 local distributors. See Bulletin T-1740.

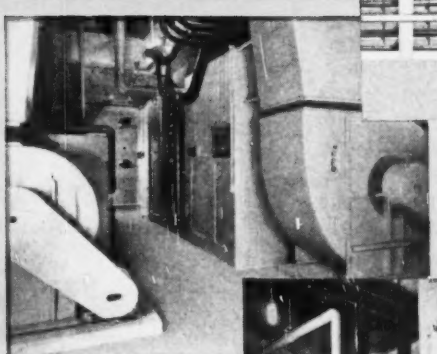
Air Conditioned Comfort

Architects and Engineers: SKIDMORE, OWINGS & MERRILL
Contractors: GALLAHER & SPECK, Inc.
MEHRING & HANSON CO.

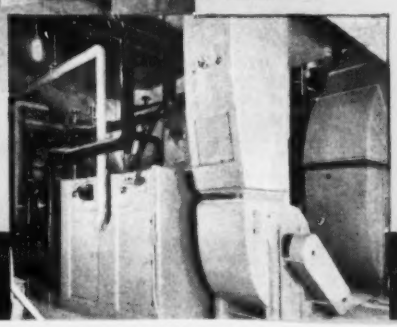


POWERS CONTROL
TEMPERATURE AND HUMIDITY

Above:
18 Smoke Vent Louvre Dampers in Bus Loading Concourse are controlled by 6" POWERSTROKE motors.

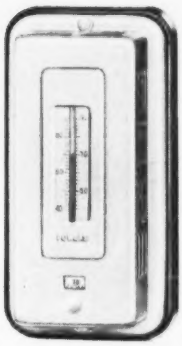


Some of the more than 20 supply and exhaust fans with a total capacity of 500,000 cfm which are Powers controlled.



in Biggest Privately Owned Bus Terminal is assured by a

POWERS PNEUMATIC SYSTEM OF *Control*



Type D Thermostat

Greyhound Corporation's new up-to-the-minute $10 million bus terminal in Chicago is completely air conditioned. The two million passengers yearly, estimated to use this building, will find every modern convenience and comfort.

On the top two levels, is a public parking space for 500 autos. On the street level and the waiting room level are 13 stores and shops, 7 restaurants and other spaces, which are air conditioned and Powers controlled.

On the bottom level is the Bus Loading Concourse with 30 platforms for arriving and departing buses. Its ventilating system has a capacity of 180,000 cfm which creates a continuous 5 mph breeze. Here 18 Smoke Vent Louvre Dampers are controlled by 6" POWERSTROKE motors. In case of emergency the dampers can be opened by 3 manually operated positive switches each strategically located in a glass covered cabinet.

Domestic Hot Water Supply for the building is furnished by steam heated storage heaters controlled by Powers No. 11 Temperature Regulators. Shower Baths thruout the building are each regulated by a Powers Thermostatic Water Mixer.

Experience gained by Powers here and in many other important large and small buildings will be helpful to you. Next time a temperature or humidity control problem arises, contact POWERS nearest office. There's no obligation.

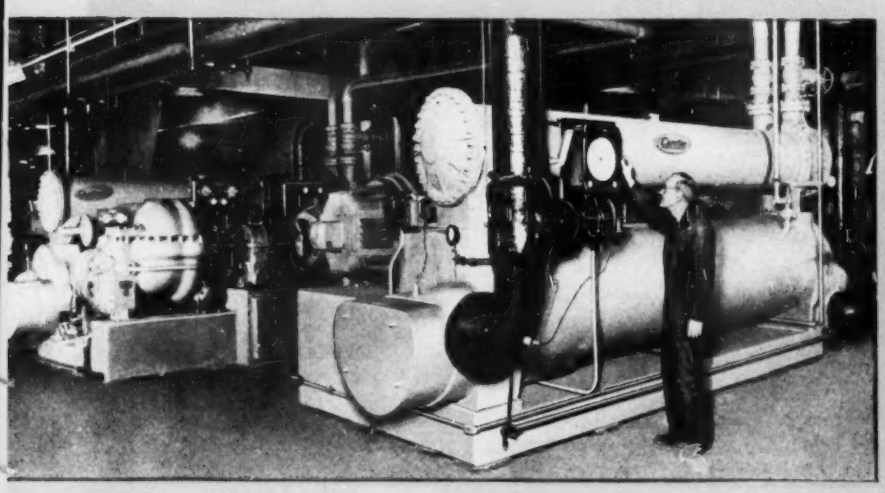
THE POWERS REGULATOR CO.

Skokie, Ill. • Offices in Over 50 Cities in the U.S.A., Canada and Mexico

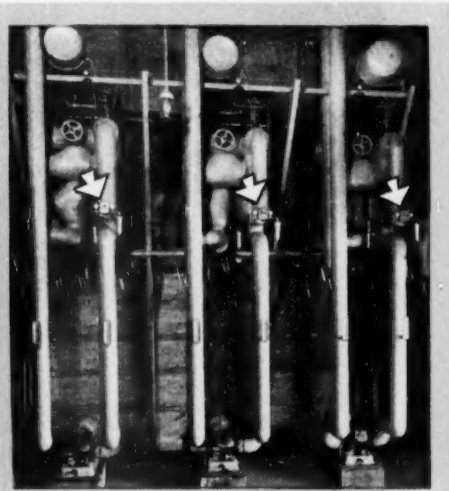
See Your Phone Book

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

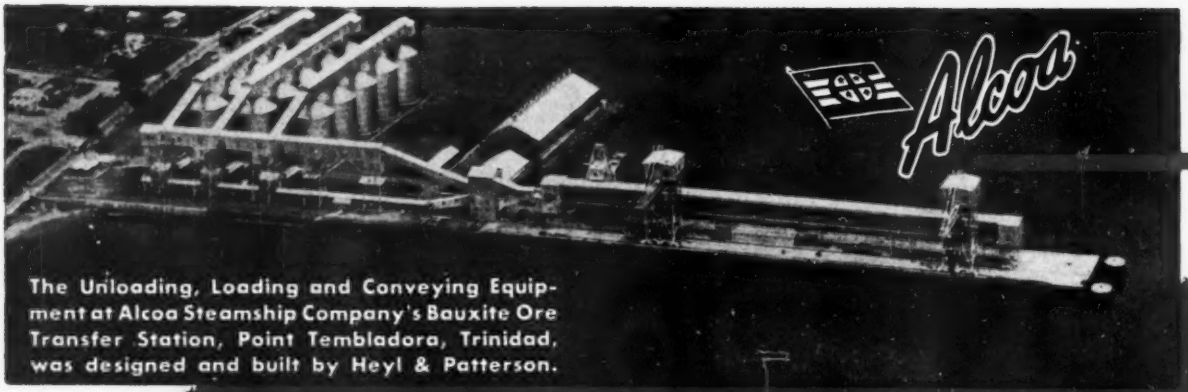
(b16)



Mr. Henry Burckert, Chief Engineer inspecting one of the two Powers Series 100 Recording-Controllers on two Centrifigul Refrigerating Compressors (610 Ton Cap.) supplying chilled water for air conditioning.



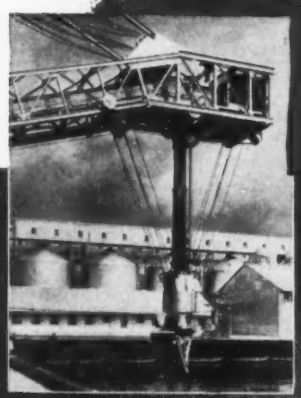
Nine Powers ACCRITEM Regulators above operate FLOWRITE diaphragm valves which control chilled water in summer and hot water in winter supplied to individual coils throughout the building.



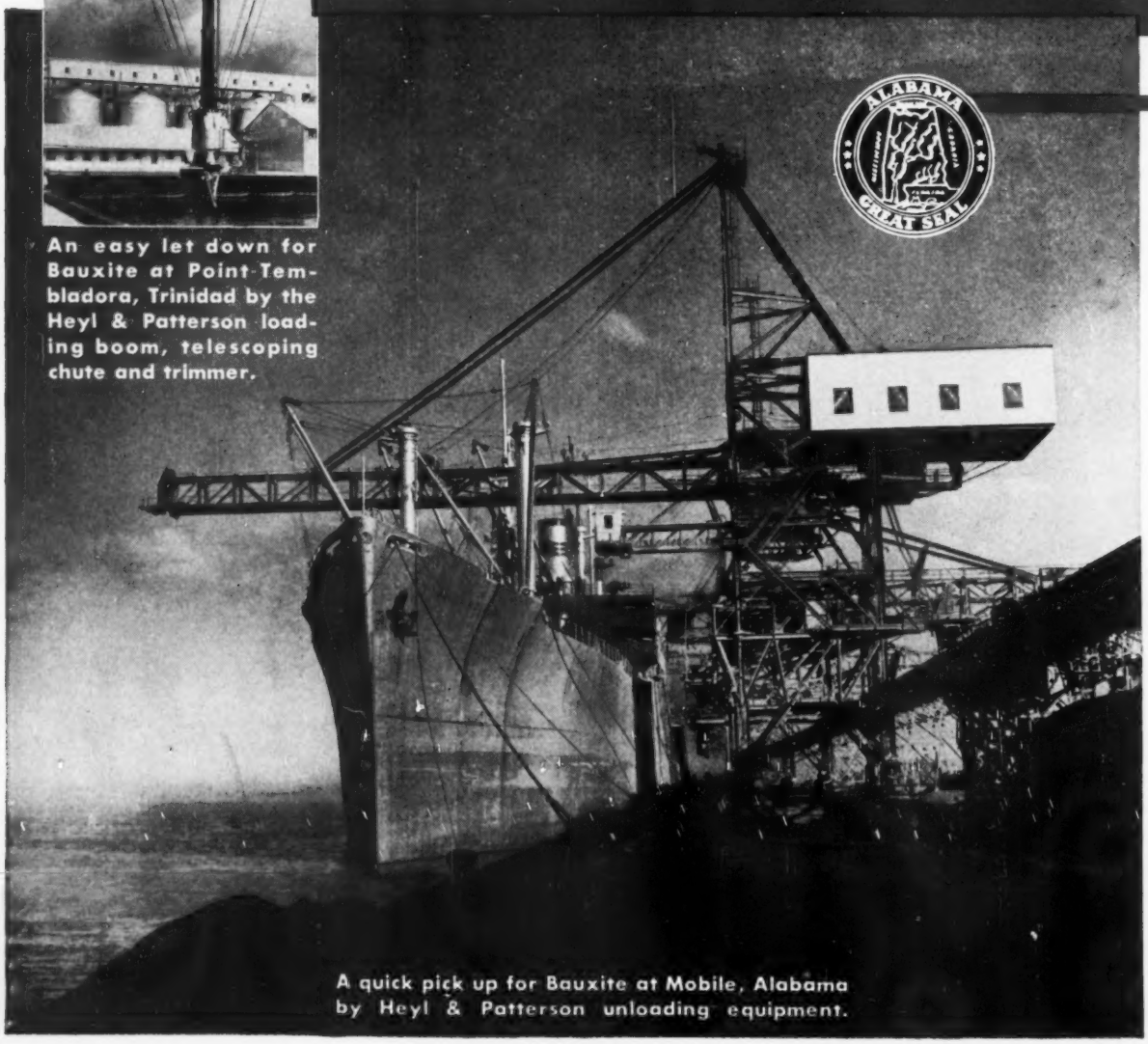
The Unloading, Loading and Conveying Equipment at Alcoa Steamship Company's Bauxite Ore Transfer Station, Point Tembladora, Trinidad, was designed and built by Heyl & Patterson.

HEYL & PATTERSON

Loading and Unloading Equipment



An easy let down for Bauxite at Point Tembladora, Trinidad by the Heyl & Patterson loading boom, telescoping chute and trimmer.



A quick pick up for Bauxite at Mobile, Alabama by Heyl & Patterson unloading equipment.

IN TRINIDAD . . . At Point Tembladora, Trinidad stands the huge Bauxite Ore Transfer Station of the Alcoa Steamship Company. Here bauxite ore is unloaded from river ships by two Heyl & Patterson Unloaders, and carried by Heyl & Patterson conveying equipment either to the storage bins or directly to the Heyl & Patterson loading facilities where the ore is deposited into the holds of ocean-going vessels.

The H & P telescoping loading chute is especially designed to lower the bauxite ore gently and quickly into the hold of the vessel at the rate of 2000 tons per hour with a minimum amount of dust.

Handles Bauxite Quickly and Easily at both ends of its Caribbean Voyage

IN ALABAMA . . . At the Alabama State Docks, Mobile, Alabama . . . the Ship, loaded with Bauxite Ore from Trinidad, docks alongside of the new Heyl & Patterson Traveling Unloading Tower. The bauxite is rapidly unloaded from the ship and deposited onto a belt conveyor for its first step to the processing plant.

This modern 800-tons-per-hour Unloader . . . designed, fabricated and erected for the State of Alabama . . . currently unloads iron ore and manganese ore as well as bauxite.

The special features of this unloading tower illustrate how it was designed to fit operating conditions at Mobile and why it is one of the finest unloaders in operation today.

(1) The Tower is equipped with an extra-long cantilever which enables material to be transferred from the ship either to the conveyor system or directly to a river barge. In the latter operation the barge is positioned at the opposite side of the ship from the Tower and the trolley moves from above the ship to the extreme end of the cantilever to load the barge.

(2) Because of the short rail spacing between the trucks, the machinery house is placed far to the rear of the tower to counter-balance the weight of the extra-long cantilever.

(3) Adjustable voltage electrical control is used to provide smooth starting and stopping and the fastest possible operation. The use of adjustable voltage lowers maintenance costs and reduces power losses.

(4) The filtered air in the machinery house is kept constantly at a higher pressure than the outside air. This prevents infiltration of dust and prevents overheating of equipment.

(5) The operator's cab is mounted on a heavy ram and moves out over the hold of the vessel when unloading. This enables the operator to have a full view of the hold at all times.

(6) Each bucket of ore can be weighed by means of a force cell application which indicates the bucket weight in the operator's cab.

Heyl & Patterson has never designed or built "catalog" loading or unloading equipment. Every Heyl & Patterson installation is especially engineered to meet the particular needs of the customer.

For *YOUR* loading or unloading problem, investigate the advantages of having your installation designed, fabricated and erected by Heyl & Patterson.

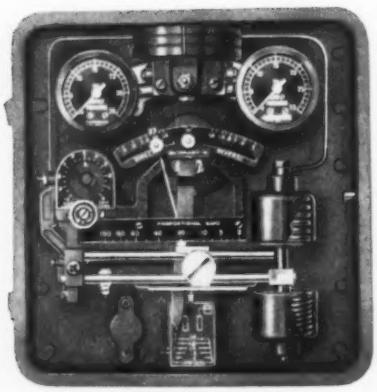
Heavy Bulk Materials Handling Equipment *All The Way from Design to Erection*

Boat Loaders and Unloaders
Ore Bridges
High Lift-Turnover-Rotary
Railroad Car Dumpers
Coal Handling Equipment
Pig Iron Casting Machines
Cyclone Thickeners
Thorsten Coal Samplers
Car Hauls and Boat Movers
Coal Crushers
Bradford Breakers

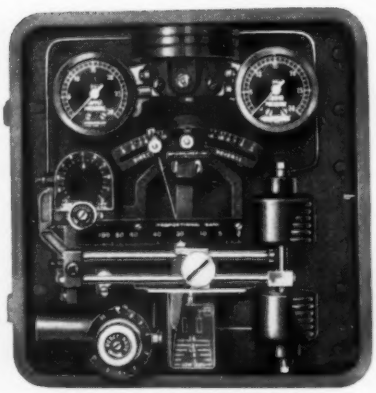
Heyl & Patterson, Inc.
"SINCE 1887"
55 FORT PITT BLVD. PITTSBURGH 22, PA.

NEW MASONEILAN 12000 SERIES

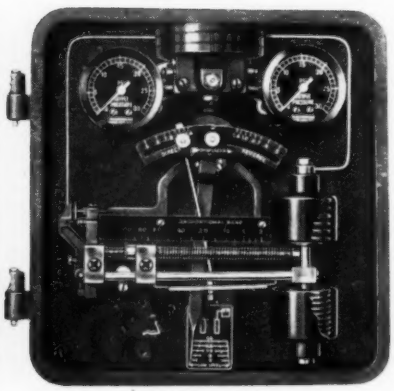
Easy to Select



Proportional Controller



Proportional-Reset Controller



Pneumatic Transmitter

20 INSTRUMENT COMBINATIONS

Proportional Controller, which may also be used as a Transmitter, and which may be converted *in the field* to a

Differential-Gap Controller by changing one piece of air tubing or to a

Proportional-Reset Controller by simple addition of the reset unit. Also

Pneumatic Transmitter; or if desired

Any Combination of Two of these — same or different units — in a larger case

Right Hand Mounting on Integral Chamber

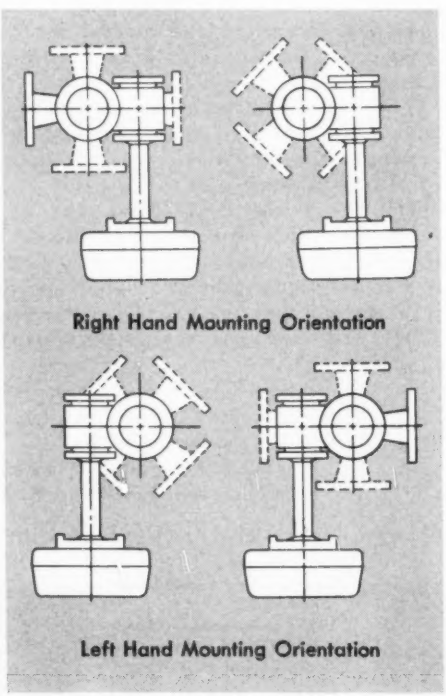
2 INSTRUMENT LOCATIONS

The instrument may be mounted to left or right of the displacer — at the factory — or in the field. No special tools — no extra parts required.

2 DISPLACER CHAMBERS 8 ORIENTATIONS

The instrument may be oriented to connections in any of eight positions when one or more side connections are used. *Mid-flange* in displacer chamber permits field orientation (or, if preferred, integral chamber with factory orientation can be supplied). Top and bottom connections permit installation of *integral* chamber in any desired position.

Left Hand Mounting on Mid-flange Chamber



Right Hand Mounting Orientation

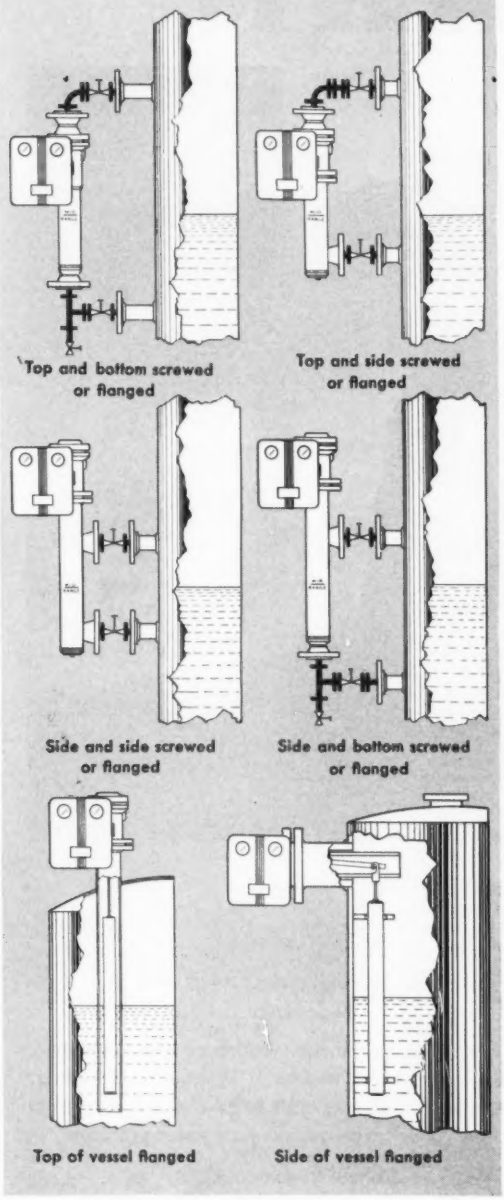
Left Hand Mounting Orientation

OVER 1,000,000

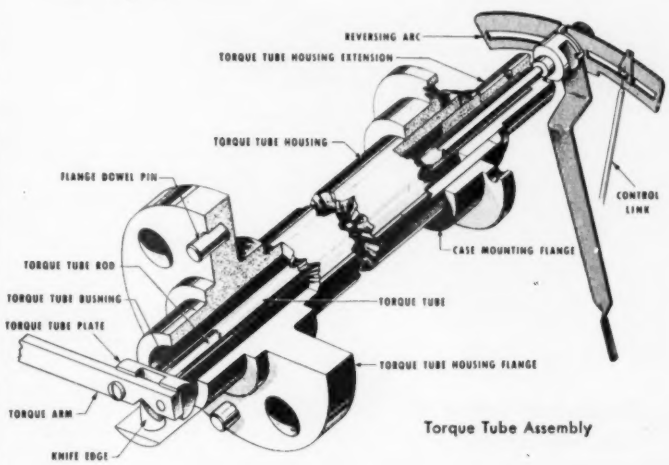
LIQUID LEVEL CONTROLLERS and Install

10 TYPES MOUNTING CONNECTIONS

A type to meet requirements of any vessel


Top and bottom screwed or flanged
Top and side screwed or flanged
Side and side screwed or flanged
Side and bottom screwed or flanged
Top of vessel flanged
Side of vessel flanged

Save time — save money! Masoneilan 12000 Series offers widest scope of selection plus design features that permit installation without delay and cost of precise preliminary layout. Convertibility *in the field* — of type of control and of orientation of instrument position to displacer and to chamber connections simplifies selection and installation. Simplified dimension schedule further assists in installation plans.



Torque Tube Assembly

9 TORQUE TUBE MATERIALS

Inconel (standard), K-Monel, Monel, Type 316 Stainless Steel, Hastelloy B or C, Nickel, Phosphor Bronze, Durimet 20.

CHAMBER or FLANGE MATERIALS

Iron, Bronze, Carbon Steel or various* Alloys available on some chamber or flange types — carbon steel or alloys on all types

*e.g. Stainless Steel, Monel, Nickel, Hastelloy, etc.

8 STANDARD RANGES

14″, 32″, 48″, 60″, 72″, 84″, 96″, 120″

Special ranges available

ALL HIGH Quality Coefficient PRODUCTS

MASONEILAN REGULATOR CO.

1186 Adams Street, Boston 24, Mass., U. S. A.

POSSIBLE COMBINATIONS

Reduce Solids Concentration *with* EFFECTIVE BLOWDOWN

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

You Need An Effective blowdown schedule to reduce solids concentration and limit heat losses in your system. Planning your schedule is easier after you've read Allis-Chalmers water conditioning Bulletin 53. It tells how to choose between a manual and a continuous system. It explains factors involved in sludge removal. And it discusses effects of alkalinity and silica concentration.

Part of Practical Library

Bulletin 53 is one of a series of Allis-Chalmers bulletins on water conditioning problems. These bulletins are the result of Allis-Chalmers experience in solving water problems for every industry, as well as the company's long background in the design and manufacture of steam turbine and power plant equipment.

Get Complete Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in all water treatments. And you can get equipment needed for any system.

COMPLETE TEST KITS for making standard feedwater and boiler water tests are supplied by Allis-Chalmers for field use. When needed, modern testing equipment and research facilities are available in A-C laboratories.

For your copy of Information Bulletin 53 on blowdown, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers representative consult with you on your water problems.

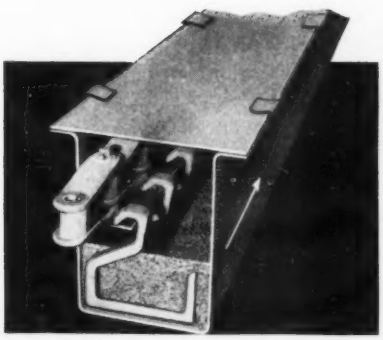
A-4008

ALLIS-CHALMERS

S-A CONVEYING *Systems* for "Demand Feeding" of Coal

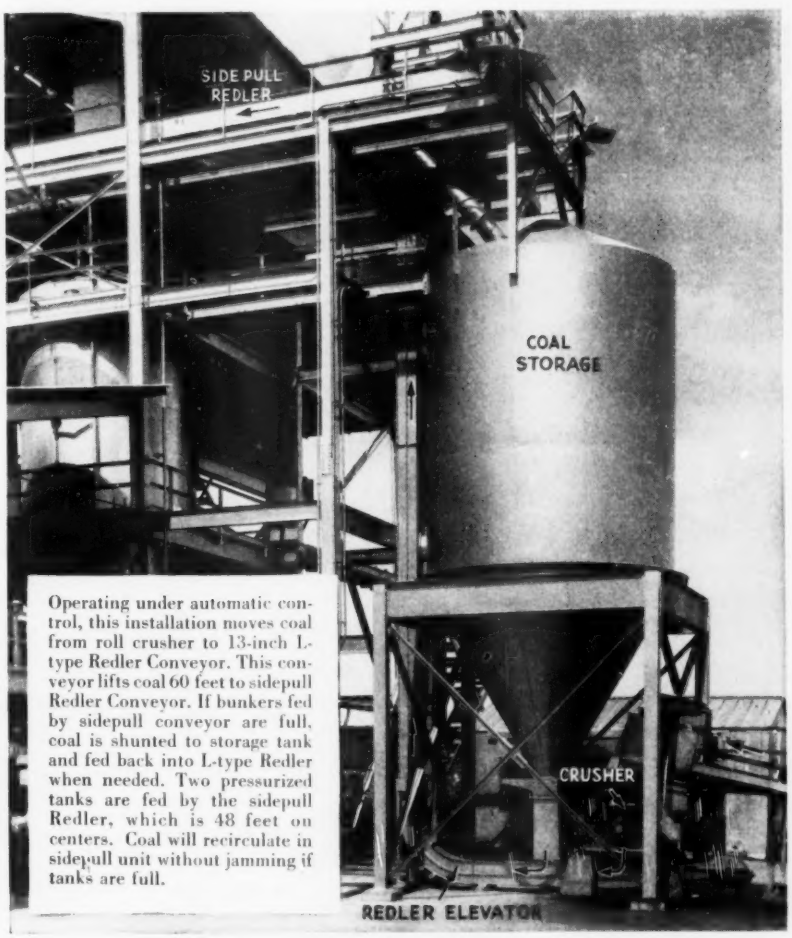
In this plant, coal is fed to overhead storage tanks by Redler Conveyors. If the tanks are full, a sidepull Redler unit will continue to circulate the coal until needed. There's no jamming or jolting off-and-on operation. Redler Conveyors are extremely compact, require minimum structural support and prevent escape of dust.

This coal handling installation is typical of the bulk handling problems S-A engineers deal with every day. Get the benefit of over 50 years of bulk handling experience *plus* a full line of conveying equipment to choose from by taking your coal or ash handling problem to S-A. Write for free survey.



Cross section through sidepull-type Redler Conveyor shows how skeleton flights and chain links traveling on track guide move bulk material in totally enclosed casing. Dust and dirt are kept in, contamination kept out.

Sidepull Redler unit is closed horizontal loop which permits recirculation when no material is withdrawn from conveyor.



Operating under automatic control, this installation moves coal from roll crusher to 13-inch L-type Redler Conveyor. This conveyor lifts coal 60 feet to sidepull Redler Conveyor. If bunkers fed by sidepull conveyor are full, coal is shunted to storage tank and fed back into L-type Redler when needed. Two pressurized tanks are fed by the sidepull Redler, which is 48 feet on centers. Coal will recirculate in sidepull unit without jamming if tanks are full.

Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll & Ring Type
Pivoted Bucket Carriers
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Track Hoppers & Bin Gates
TELLEVEL Bin Level Controls
Water Intake Screens
SEALMASTER Ball Bearing Units

Write for bulletin on any of the above

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Ave., Aurora, Illinois — Los Angeles, Calif. • Belleville, Ont.

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

For complete satisfaction, install POWELL VALVES

To be completely satisfactory, a valve must function perfectly, give maximum length of service and require minimum maintenance. To do this it has to be exactly right—in design and materials—for the conditions under which it must operate. And because Powell makes such a valve for every known flow control service in the modern power plant—industrial or utility—Powell Valves give complete satisfaction.

Fig. 16003 W. E. 600-pound Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.

The Wm. Powell Company
Cincinnati 22, Ohio

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve for water, oil, gas and low pressure steam services. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge. Made in sizes 2" to 30", inclusive.

Fig. 500—125-pound Bronze Gate Valve with screwed-in bonnet, screwed ends, inside screw rising stem and tapered wedge; solid in sizes ¼" to ¾"; double in sizes 1" to 3", inclusive.

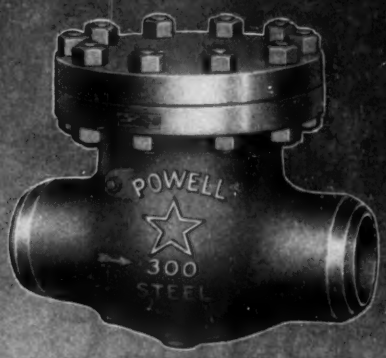
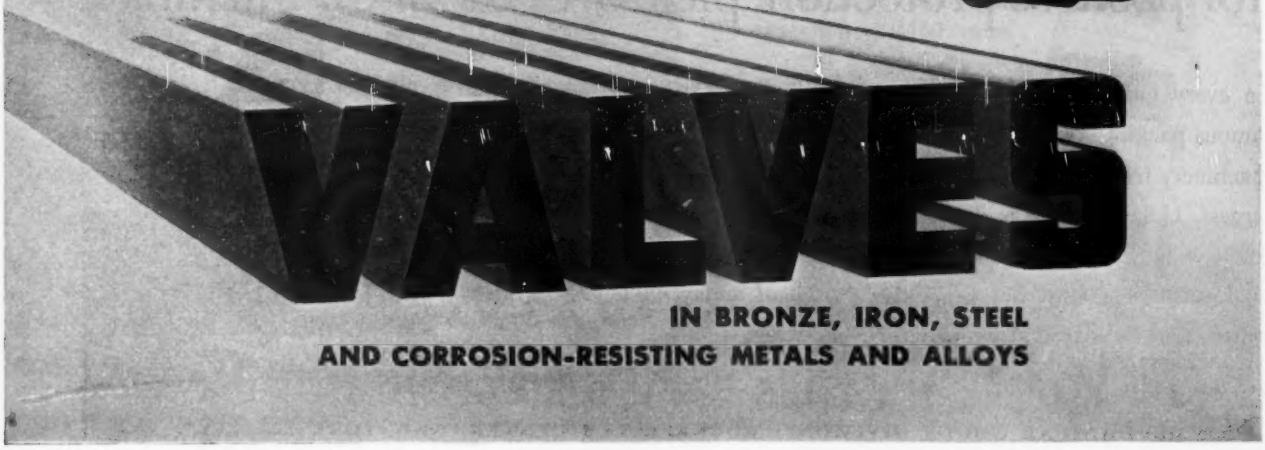


Fig. 3061 W. E.—300-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

Fig. 3031 W. E.—300-pound Cast Steel Globe Valve with welding ends, bolted flanged yoke and outside screw stem.

Fig. 1314-A — 1500-pound Steel Integral Bonnet "Y" Valve with socket weld ends. Sizes ⅛" to 2", incl.

DEPENDABLE VALVES
SINCE 1846



IN BRONZE, IRON, STEEL
AND CORROSION-RESISTING METALS AND ALLOYS

for positive protection, pick U. S. Rainbow Packing!

In every industry you'll find this famous packing—on every piece of machinery from the smallest to the largest. U.S. Rainbow is designed for packing flanges and other parallel surfaces against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions. These gaskets will not blow, nor squeeze out in service. Reduce shutdown time to a minimum—with U.S. Rainbow, *the original and genuine "Red" Sheet Packing.*

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Packard chose CLARAGE

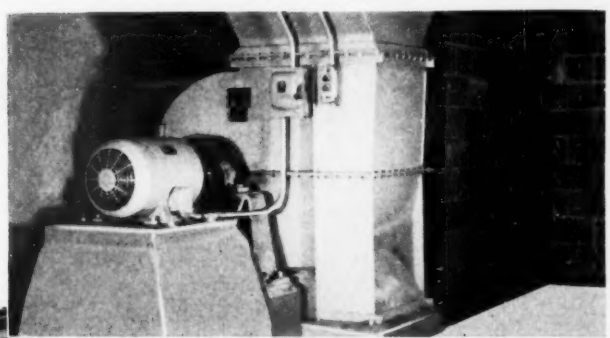
This is the new Packard Motor Car Company power plant in Utica, Michigan—expertly designed to generate steam at lowest cost.

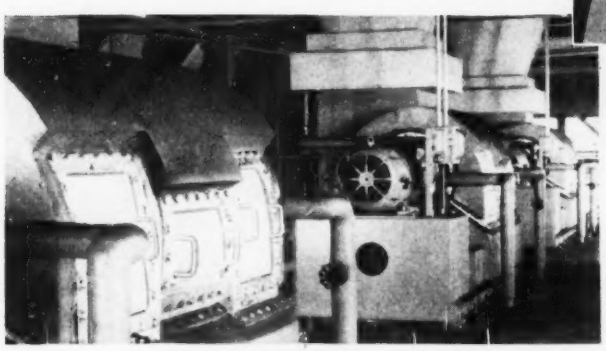
Packard installed Clarage heavy-duty draft fans — *a very wise decision!*

. . . for as the years go by, Clarage fans will pay off time and time again — meeting varying load demands *exactly*, operating *more economically*, giving round-the-clock service with an *extraordinary freedom* from maintenance and repairs.

3 FORCED DRAFT FANS

OPERATING DATA: — Each forced draft fan (equipped with Clarage Vortex capacity control) has a certified rating of 11,000 c.f.m. of standard air at 3" static pressure when operating at 1160 r.p.m.

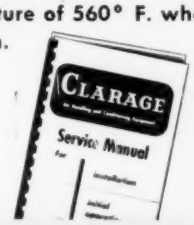




3 INDUCED DRAFT FANS

OPERATING DATA: — Each induced draft fan (equipped with Clarage water-cooled bearings) has a certified rating of 18,000 c.f.m. of flue gases at a temperature of 560° F. when operating at 1160 r.p.m.

Want to know the secret of the superior performance you get from Clarage fans? Then write for the Clarage Service Manual — which tells all! 78 pages of valuable information on your BEST BUY in air handling and conditioning equipment. Clarage Fan Company, Kalamazoo, Michigan.



You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES-ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA Canada Fans, Ltd., 4285 Richelieu St., Montreal

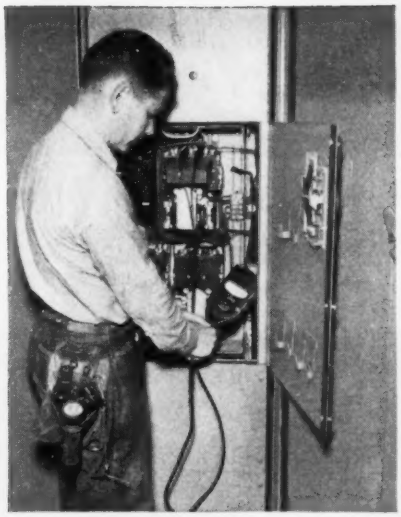
Speed Electrical Testing with G-E Hook-ons

AK-1A
Volt-ammeter provides rapid one-hand operation

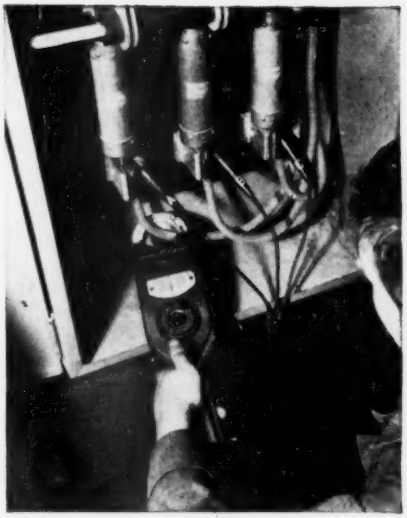
AK-2
Wattmeter measures without service interruption

AK-3
Power-factor meter saves time with direct readings

EASY ONE-HAND OPERATION makes this volt-ammeter ideal for line use, as in checking distribution circuits.



SPOTTING OVERLOADS is simple with the compact, lightweight G-E hook-on wattmeter even in many relatively inaccessible places.



DIRECT DIAL-INDICATON is a time-saving feature of the G-E power-factor meter, particularly in survey and installation work.

G.E.'s Three Proven Hook-on Instruments Now Immediately Available from Stock

Your order for G-E hook-on instruments can now be filled immediately—to help you at once in reducing today's high electrical maintenance costs by reducing maintenance time.

Since all three of these a-c instruments will work on insulated as well as non-insulated conductors, you do not have to cut conductors when taking measurements. This means you can forget about costly service interruptions and equipment shutdowns.

USERS REDUCE TESTING TIME

The following user comments show how G-E hook-on instruments have demonstrated their value in rapid, low-cost maintenance—

"My AK-1A cuts my electrical testing time in half."
(Maintenance Man)

"With my new AK-2 hook-on wattmeter I can do this job in a quarter of the time it formerly took me with conventional instruments." (Plant Superintendent)

"My hook-on power-factor meter alone does the job previously done by using a wattmeter, two current transformers, two ammeters, and a voltmeter." (Engineer)

EIGHT-RANGE VOLT-AMMETER

Eight quickly readable scales (five current ranges and three voltage ranges) make the G-E hook-on volt-ammeter suitable for a wide variety of applications. Use the AK-1A volt-ammeter for measuring load on power and distribution transformers, as well as for load balancing and load surveys on distribution circuits.

VERSATILE HOOK-ON WATTMETER

With the AK-2 hook-on wattmeter you get accurate power readings on either single-phase or polyphase circuits. A few of this instrument's many uses are: checks on switchboard and panel instruments, load surveys, and complaint investigations.

MEASURE POWER FACTOR DIRECTLY

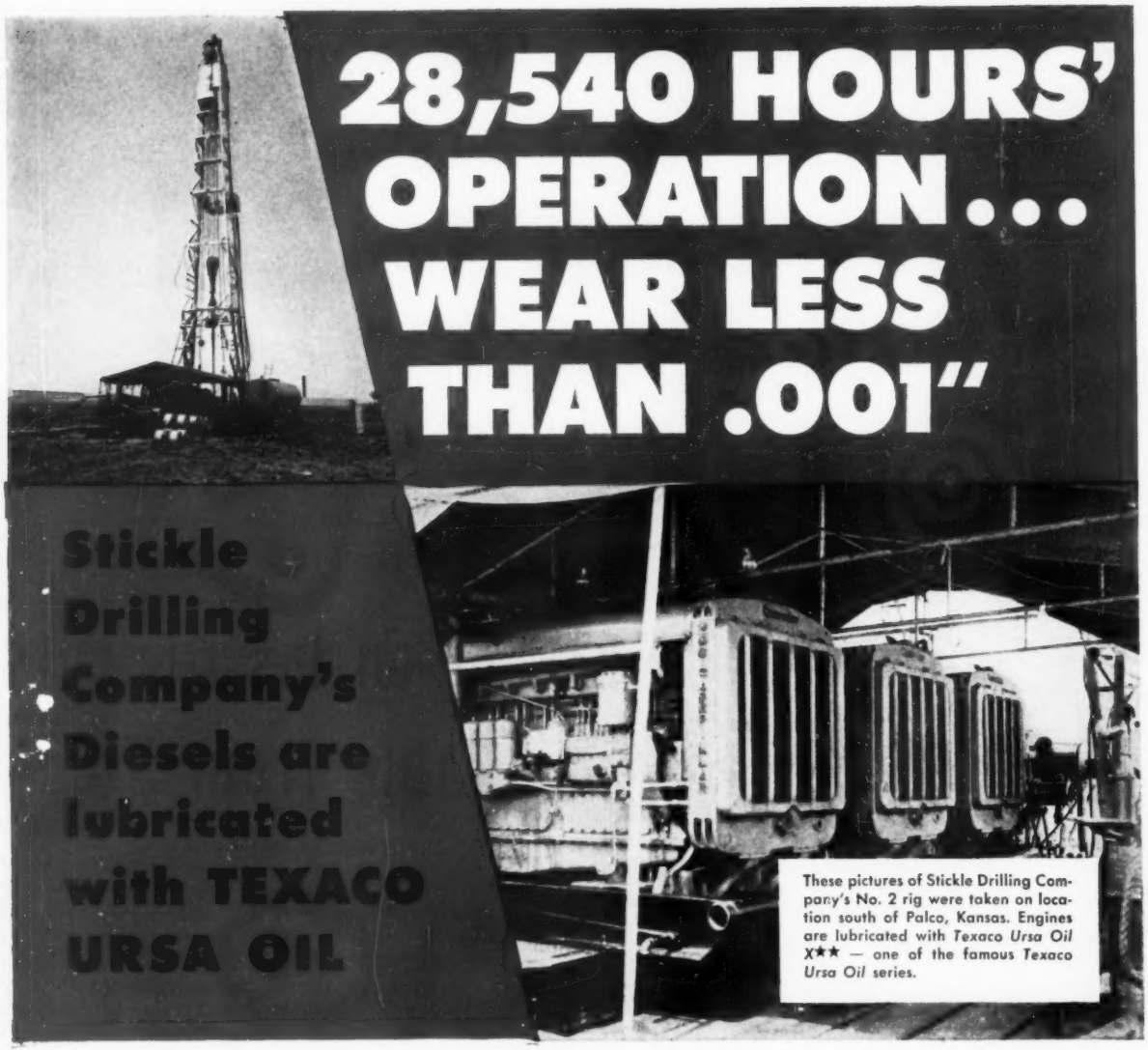
The AK-3 power-factor meter gives you a direct reading, eliminating the time and errors involved in calculations. Designed for use on polyphase circuits, this handy instrument is especially useful for installing capacitors and synchronous condensers.

PHONE NOW FOR PROMPT SHIPMENT

To make sure that these accurate instruments are at hand for your immediate testing needs, phone your G-E Apparatus Sales representative today. For further information on G-E hook-on instruments write for GEC-901 to Section 602-270, General Electric, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC


28,540 HOURS' OPERATION... WEAR LESS THAN .001"
Stickle Drilling Company's Diesels are lubricated with TEXACO URSA OIL
These pictures of Stickle Drilling Company's No. 2 rig were taken on location south of Palco, Kansas. Engines are lubricated with Texaco Ursa Oil X★★ — one of the famous Texaco Ursa Oil series.

Stickle Drilling Company, Tulsa, Oklahoma, has long been getting outstanding performance from Diesels lubricated with *Texaco Ursa Oil*. Typical are the three Caterpillar Diesels operating the No. 2 drilling rig. These were taken down for inspection after 28,540 hours of operation, and the following report gives the story:

"We found that *Texaco Ursa Oil* had kept these engines ideally clean. Measured wear was under one-thousandth of an inch. Since then, the engines have been back in operation for over 10,000 additional hours without any down time."

You can get similar fine performance by using the recommended member of the famous *Texaco Ursa Oil* series — *a complete line* of lubricating oils for Diesel, gas and dual-fuel engines. Whatever the type, size or speed of your engines, their operating conditions or fuel used, there is a *Texaco Ursa Oil* to assure clean, efficient performance with minimum maintenance costs and fuel consumption. The *Texaco Ursa Oil* series is approved by leading engine builders and preferred by operators everywhere.

A Texaco Lubrication Engineer will gladly give you full information. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

3200 Psi in 1923

THIRTY YEARS AGO, in the spring of 1923, POWER received a phone call from a stranger named Mark Benson. He had just landed in New York from England and was encamped at the Commodore Hotel. He wanted to see an editor. I was then an assistant editor, and was sent over to see what it was all about.

Benson pulled out a big sheaf of diagrams, tables and calculations—all relating to his radical proposal to generate steam at the critical pressure of 3200 psi in a once-through boiler.

With his permission I photostated all the papers and sweated out the two long articles published in POWER, May 22 and 29, 1923. These excited much interest all around the world. Digests appeared in the leading engineering journals of England, Germany and Russia.

With the cooperation of the English Electric Co, Benson was aiming primarily to provide 1500-psi steam for turbine operation without paying the price of the heavy boiler drum required for that pressure. He reasoned that feedwater pumped through boiler tubes at pressures slightly above 3200 psi would turn quietly into steam at the point where the fluid reached the critical temperature of 706 F. There would be no boiling—no steam bubbles to disengage, so no drum would be needed.

The 3200-psi steam would be throttled to 1500 psi and superheated before going to the high-pressure turbine.

Presumably, the very moderate steam temperatures then permissible, and the very small capacity of the proposed pilot plant (1000 kw) made it uneconomical to operate the turbine at 3200 psi, despite the obvious power waste in pumping feedwater at more than 3200 psi to produce turbine throttle steam at 1500 psi.

Here are some of Benson's proposed conditions: boiler outlet 3200 psi (plus) and 730 F; throttling to 1500 psi and superheating to 788 F; expansion to 200 psi in a tiny one-stage impulse turbine running at 20,000 to 25,000 rpm; reheating to 662 F; final expansion to 0.5 psi in a 7000-rpm gear-connected turbine. These were paper plans, not operating results. All pressures are absolute.

Now let's move on 13 years to March 12, 1936. I was in Berlin interviewing Dr Gleichman, chief engineer of the big Siemens-Schuckertwerke. Dr Gleichman kidded me about his bald head—said it was my fault. It seems that Siemens first heard of the Benson boiler through the POWER articles. Later, they bought the world patent rights from the English Electric Co. Gleichman said it took him years to get the unit working properly. As a result he lost a lot of sleep and tore out a lot of hair. Hence the bald head—which was my fault.

After 1929, however, Dr Gleichman continued, it was a different story. He got the unit under control, but operating well below the critical pressure—anywhere from 1200 psi to 2500 psi, depending on the load. Further details may be found on page 246 of May, 1936 POWER if anybody is interested.

In time, the Benson boiler came into wide use in Germany—also in Russia under the name Ramsin. We don't know that it was ever commercially operated at critical pressure, but it did operate without a drum, which made it attractive to steel-poor Germany just before the second World War. At that time about 170 units were running on land and sea.

It's worth noting again that Benson's announced purpose was merely to eliminate the costly high-pressure boiler drum. Under the technical limitations of his time it does not appear that he planned to operate turbines at the critical pressure or higher. It is a far cry from his ingenious pioneer proposal to present plans for an ultra-high efficiency plant with a throttle pressure of 4500 psi.—PWS

FIVE CENTRAL
SPECIFY KENNEDY
selection based on proven

FULLY AIR SWEPT

•

COAL PULVERIZED TO SUPERFINENESS

•

COAL COMPLETELY CARBURETED . . . Ready for combustion

•

BIG TRUNNIONS FOR AIR SWEEPING

•

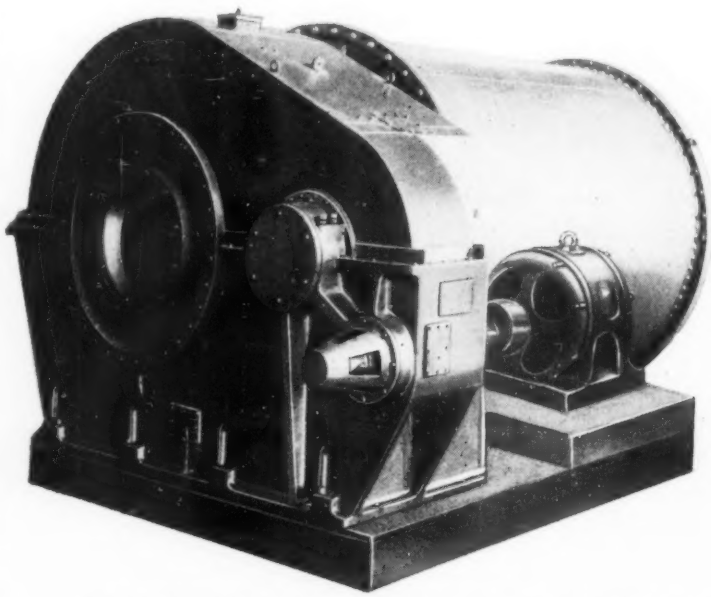
BALLS ADDED WITHOUT SHUTTING DOWN

•

LOW OPERATING AND MAINTENANCE COSTS

•

UNBURNT CARBON LOSSES LESS THAN ½%



AIR SWEPT TUBE MILLS Slow-speed ball mill for perfect pulverization. Low-cost grinding, regardless of hardness. Balls can be added without shutting down. Continuous operation, better than 99% availabilty.

The contracts placed by these five important Central Power Stations involve 30 KVS Air Swept Tube Mills, designed to pulverize coal for generation of 6,350,000 lbs of steam per hour in John Thompson boilers. The following plants and equipment are included:

TILBURY POWER STATION, LONDON—five units, each designed for 550,000 lbs. per hour at 950 lbs. per sq. in. and 925° F.

MARCHWOOD POWER STATION, LONDON—four units, each designed for 550,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.

BRIMSDOWN POWER STATION, LONDON—two units, each designed for 340,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.

PULROSE POWER STATION, ISLE-OF-MAN—two units, each designed for 60,000 lbs. per hr. at 425 lbs. per sq. in. and 775° F.

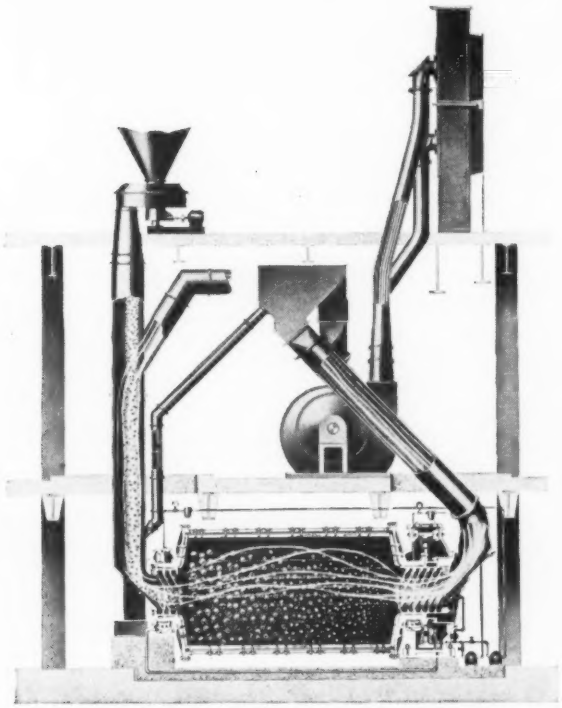
WALLERAWANG POWER STATION, AUSTRALIA—two units, each designed for 300,000 lbs. per hr. at 650 lbs. per sq. in. and 870° F.

IT COSTS LESS.. TO OWN THE BEST!

POWER STATIONS

AIR SWEPT TUBE MILLS

economy of operation!



KENNEDY COAL FIRING SYSTEM showing disc feeder, pulverizer, classifier, exhauster and burners.

For maximum combustion with all grades of coal, KENNEDY Air Swept Tube Mills have no equal The cumulative savings in fuel costs made possible through complete combustion, reach tremendous amounts. Maximum heat value is obtained from every ton of coal burned producing *more heat and more power* from any given quantity of coal.

KENNEDY Air Swept Tube Mills are built to provide extremely fine puverization, making possible the efficient burning of any grade of coal from the cheapest to the highest. Save money on your coal costs. Stop buying premium coal and *save more than a dollar per ton!* KENNEDY equipment will do this for you. Get the facts today.

INSTANT RESPONSE TO CONTROLS

•

85% TO 90% THROUGH 200 MESH

•

20% MOISTURE REMOVED WHILE PULVERIZING

•

PULVERIZES *ANY* COAL, BITUMINOUS, ANTHRACITE, COKE BREEZE

•

TRAMP IRON ACTUALLY AIDS IN PULVERIZING

•

RESERVES OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND

SEND FOR bulletins describing KVS coal firing systems and waste heat boilers.

KENNEDY - VAN SAUN
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SPECIAL *Chill* CAST

BRONZE GEARS

HARDENED AND GROUND STEEL WORMS

Advantages of Philadelphia Worm Gear Reducers

To insure long, dependable service from Philadelphia Worm Reducers, the greatest care and research goes into the selection of materials for the worms and worm gears. The predominant sliding action dictates the use of dissimilar metals to minimize frictional wear.

Philadelphia Worms are of alloy steel with hardened threads. Shaft and threads are smoothly ground and polished after hardening. The result is increased gear life through improved surface finish.

Worm Gears are of high quality chill cast nickel bronze to provide greatest strength, with a low coefficient of friction against the worm.

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LimiTorque Valve Controls

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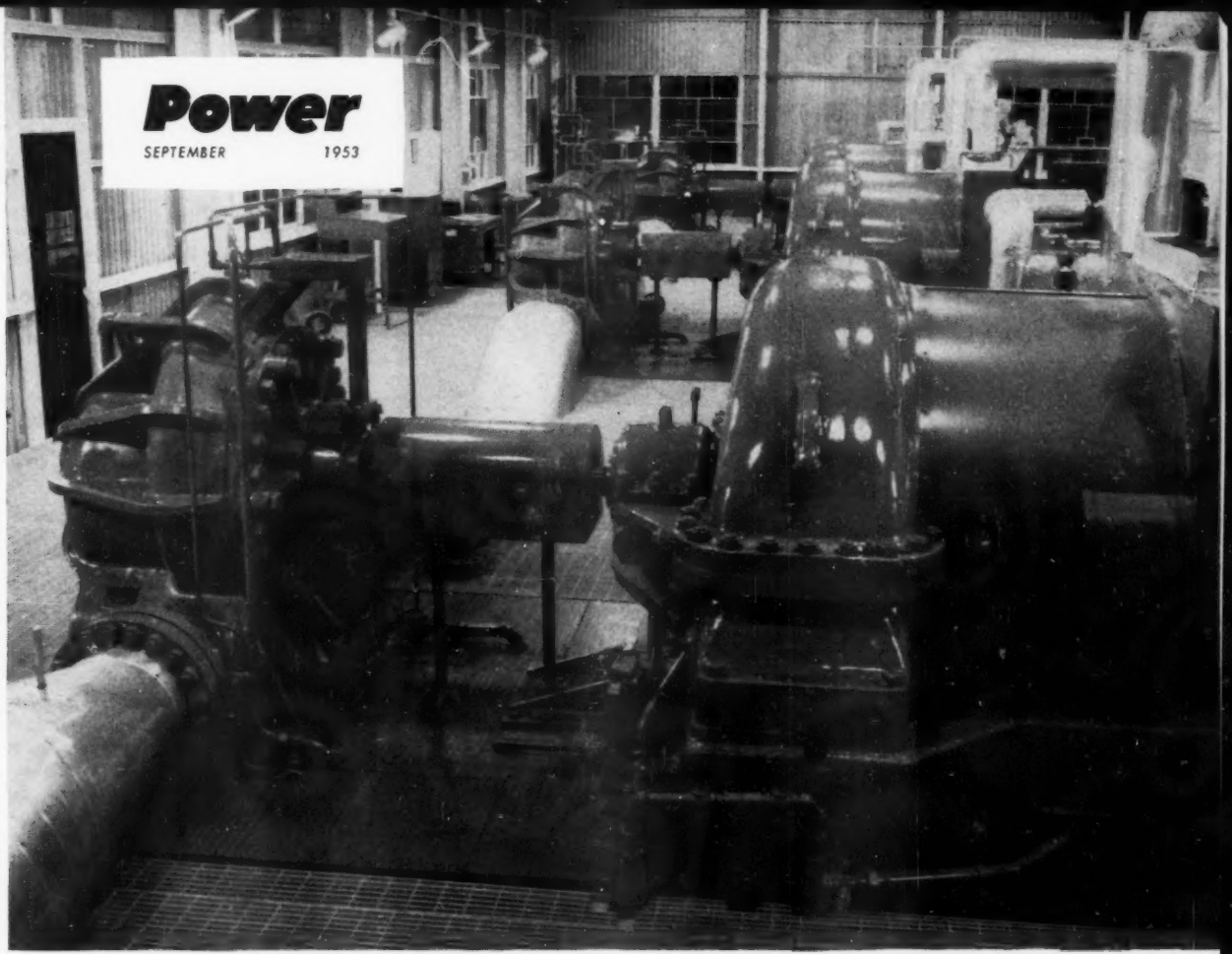
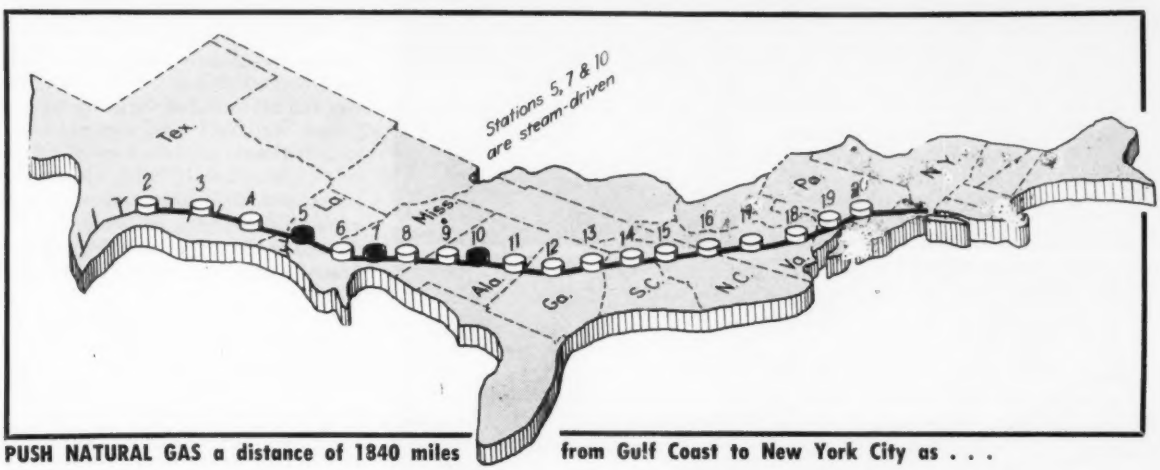
SEPTEMBER 1953



CENTRIFUGAL GAS COMPRESSORS, driven by steam turbines, team up with engine-driven units to . . .

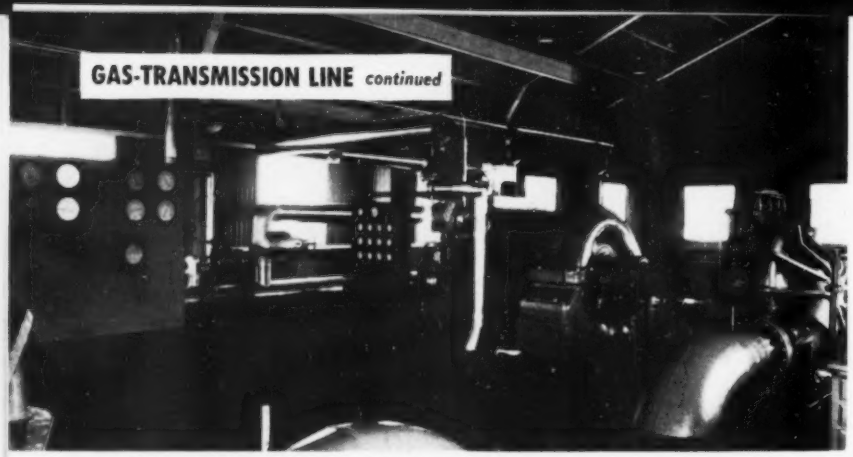


PUSH NATURAL GAS a distance of 1840 miles from Gulf Coast to New York City as . . .

Gas Pipeline Harnesses Steam

By **L L NUNLEY**, *Station No. 5 Superintendent, Transcontinental Gas Pipe Line Corp*

TURN PAGE ►

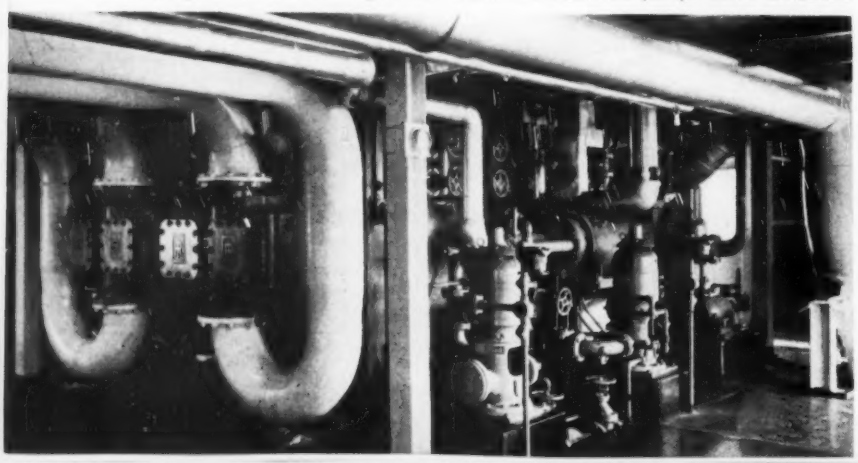


5000-HP TURBINE-COMPRESSOR SET mounts directly on condenser underneath floor. Panel, *left*, carries operating instruments for steam flow and boiler-drum water level

Here's the first natural-gas transmission line that uses steam power to drive turbo-blower centrifugal gas compressors in 3 plants. It is owned, operated by Transcontinental Gas Pipe Line Corp

BOILER-CONTROL PANEL, left, stands in front of boiler burner fronts. Two 800-kw turbine-generator backpressure units supply station electric power, heat feedwater

4600-SQ-FT SURFACE CONDENSER supporting main turbine and compressor uses circulating water from cooling tower. Vertical condensate pumps serve condenser



► THIS 30-IN. PIPELINE SYSTEM, 1840 miles long, begins at Mercedes, Texas, and extends to New York City. Gas gathered in the Texas Gulf Coast area and in south Louisiana moves to the New York City terminus through 19 compressor stations about 80 miles apart. Three of the stations use steam turbines to drive centrifugal gas compressors. The other 16 have conventional gas engines.

The three steam stations are the first to be used on a gas-transmission line, see sketch, p 73. They have proven practical, economical and well adapted to this service. Water availability was an important factor in locating the steam stations. Station No. 5 at Eunice, La. uses about 300,000 gal per day.

Station No. 5 consists of three 5000-hp compressor units, a total of 15,000 hp. Multistage impulse-reaction turbines, running at a top speed of 5000 rpm, connect direct to their compressors through oil-filled couplings.

Each turbine and compressor set mounts directly on a condenser to make up a package unit. The air ejectors together with their after-condensers and miscellaneous piping mount directly on the side of the condenser. Vertical condensate pumps set in close to the unit to conserve space.

The three 11-stage impulse-reaction turbines have labyrinth packing on both high- and low-pressure ends of the shaft. A bar-lift arrangement opens and closes the four steam-regulating valves. A shaft-end oil pump mounted on the end of the turbine force-feeds the bearings at 15-psig pressure.

Lubricating System. Both turbine and compressor have a common lubricating reservoir. The 60-psig oil of the turbine hydraulic-control system supplies oil to the seal-oil pump for the compressor shaft seal. Oil pressure on the shaft seal is controlled by the discharge-gas pressure of the compressor through a differential regulator. Oil pressure is held at about 50 psig above the gas

pressure, to insure proper sealing at all times. A 50-gal oil tank mounts over each unit near the top of the building to insure oil supply to the blower seal should a pump fail.

Tanks and pumps have alarms to alert the operator in a failure. The tank holds a 20-minute supply of oil. The compressors are piped for series operation, p 76.

Compressors. The entire gas flow must pass through each unit to be compressed to the final station discharge pressure. Bypass lines allow taking any one of the units out of service without affecting the remainder. Each unit is separately regulated with automatic oil-operated controllers. Units may be operated by fixed speed or by pressure control, depending on the discharge orders from the dispatching center.

Compressors are designed to operate at a maximum pressure of 819 psig. Normally, discharge pressure is 800 psig, normal suction pressure is 450 psig at full-load conditions. Compressor case is cast steel, heavily ribbed, hydrostatically tested up to 1200 psig. Compressor impeller is similar to a centrifugal water-pump impeller.

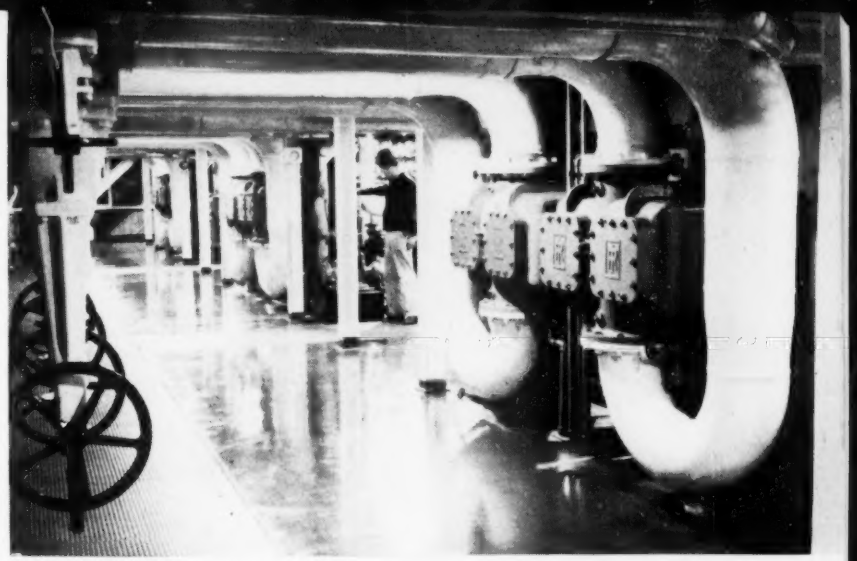
Each unit is protected for oil failure, overspeed, and pipeline failure. Should any of these conditions develop on one of the units, the remaining units automatically shut down, and all gas valves on all compressors close by electrical means. To close all valves in the station takes 27 seconds.

Power Station. The three steam generators have integral furnaces. Each produces 43,000 lb per hr of 625-psig 750-F steam. Each boiler has forced- and induced-draft fans, superheater, desuperheater, and air preheater. Bailey pneumatic controls regulate combustion rate, and feedwater and steam temperatures. Complete instrumentation makes the station simple and efficient to operate.

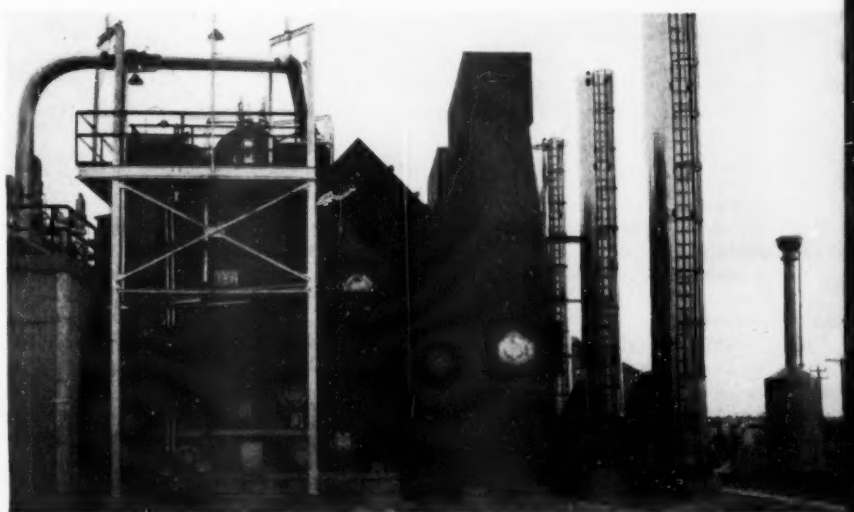
Two 1000-kva 460-v 3-phase 1200-rpm turbine-generator sets generate all station power. Three helical reduction gears connect the 5825-rpm turbine to the generator. All bearings are lubricated by forced-feed, developed by shaft-end oil pumps. All station electric motors run off the 440-v station bus. Transformers are used only for lighting purposes.

Four 100-hp motors drive the four vertical boiler-feed pumps. Three are needed to carry full station load, with one held in reserve.

The 15,000-gpm cooling tower has six sections with six 17-ft fans and six 2500-gpm circulating pumps. The cooling water serves the three main conden-

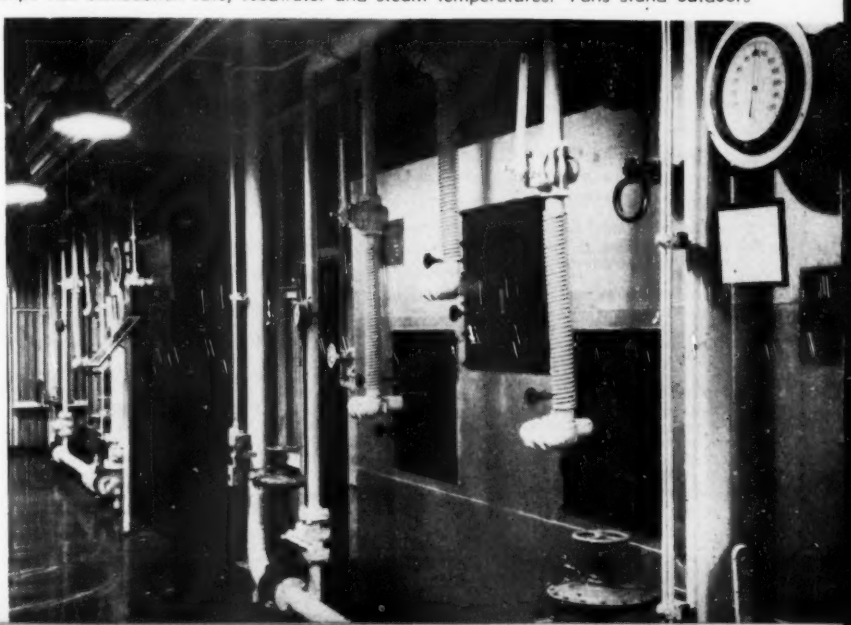


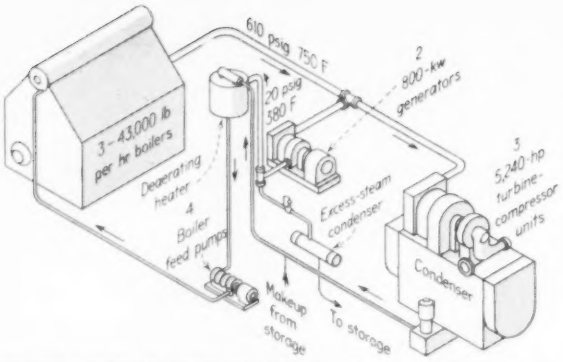
CONDENSER-ROOM AISLE shows low headroom needed by units, accessibility of tube-sheet manholes. Steam-jet air pumps mount directly on sides of condensers



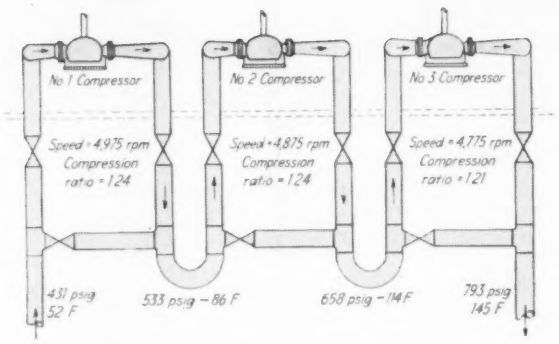
43,000-LB-PER-HR BOILERS stand outdoors with firing panels housed, *at left*, in plant building. Three integral-furnace units produce 625-psig 750-F steam for five turbines

THREE NATURAL-GAS BURNERS serve each boiler. Pneumatic automatic controls supervise combustion rate, feedwater and steam temperatures. Fans stand outdoors





SIMPLE STATION HEAT BALANCE yields plant thermal efficiency of 21.5% with boiler efficiency running at 83.8%



THREE GAS COMPRESSORS normally run in series to produce over-all compression ratio of 1.84, 93-F temperature rise

sers and the excess-steam condenser, see heat balance, sketch above.

Exhaust steam from the main turbines enters the 4600-sq-ft condensers at 2.5-in.-Hg abs pressure. The condensate collects in the hotwells for pumping to the deaerating heater.

The station 800-kw power units use main steam and exhaust it to the deaerating heater at 20 psig, heating the feedwater to 259 F. This exhaust steam is also used for sealing steam, and for heating the main fuel gas to the plant boilers.

Performance. Tests show that boiler steam output distributes: 80.53% to turbine-compressor units, 13.51% to auxiliary turbine-generators, 3.74% to feedwater heating, 1.91% to condenser steam-jet air pumps, and 0.31% to miscellaneous. Makeup to the feedwater system is about 1% of the total steam generated. An over-all boiler efficiency of 83.8% and Rankine-cycle efficiency of 73.8% for the main turbines develops an over-all plant thermal efficiency of 21.5%.

The steam turbine-gas compressor combination has a great deal of flexibility, both in speed, load control and removal of units from service. The entire pipeline compressor equipment includes 115 reciprocating-engine compressors and nine steam-driven turbo-blower compressors. To maintain deliveries of gas to market all pipeline equipment must run at load factors of 90 to 95%. This means nearly continuous operation of all apparatus.

Maintenance. Engines go out of service every 30 days for inspections. These include examinations of spark plugs, distributors, ignition systems, and other small items. Minor repairs are made at this time. Average downtime runs about one hour.

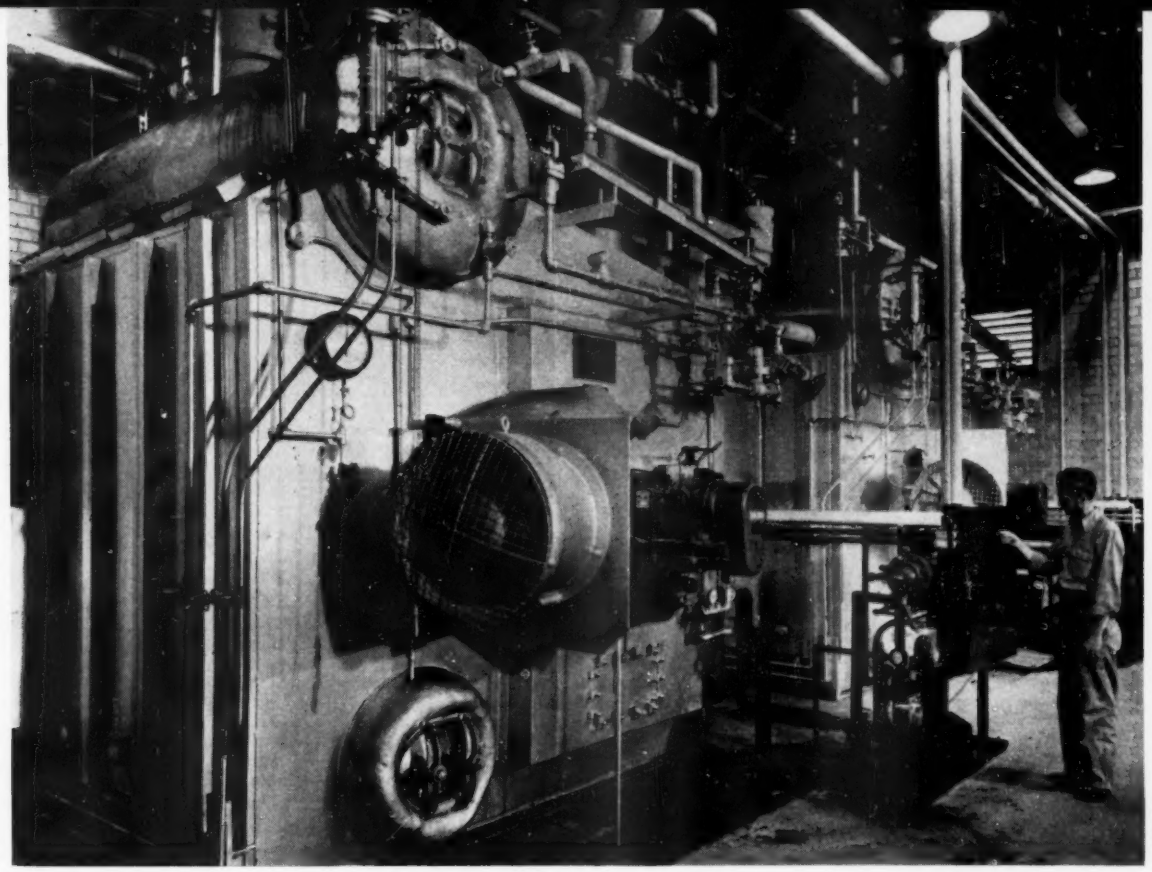
Once a year the engine compressors are removed from service for a complete internal inspection of cylinders, pistons, piston rings, crankshafts, connecting rods, valves and other parts.

The steam turbines, turbo-blower compressors, and boilers in the steam-driven plants are also removed from service once a year for internal inspections. The scheduling of these inspections, along with over-all coordination between stations is closely timed. Under the present method of inspection, each station removes from service one unit at a time. This means 19 stations make similar inspections simultaneously. This continues for about two weeks, 24 hours a day, until all stations have completed their inspections of all equipment. While this inspection is under way, gas delivery is either curtailed or gas is purchased from sister companies in the market area to meet delivery demands.

PRINCIPAL POWER-PLANT EQUIPMENT

Station No. 5—Transcontinental Gas Pipe Line Corp, Eunice, La.

Main turbines, 3 ..... Ingersoll-Rand Co
4820 to 5240 hp, 4800 to 5050 rpm, 600-psig 750-F throttle steam, 2.5-in. Hg abs exhaust
Gas compressors, 3 ..... Ingersoll-Rand Co
7560-cfm centrifugal, single stage, single flow
Gas-pressure regulators, 3 ..... Askania Regulator Co
Constant pressure, constant speed
Steam-jet air ejectors, 3 ..... Ingersoll-Rand Co
Two stage, twin element, 300-psig steam supply
Main condensers, 3 ..... Ingersoll-Rand Co
Surface type, 4600 sq ft, supports turbine and compressor
Steam generators, 3 ..... Babcock & Wilcox Co
43,000 lb per hr, 625-psig 750-F steam, integral furnace type
Auxiliary-power turbines, 2 ..... DeLaval Steam Turbine Co
800 kw, 600-psig 750-F throttle, 20-psig exhaust, 5825 rpm
Auxiliary power generators, 2 ..... Ideal Electric & Mfg Co
1000 kva, 460 v, 3 phase, 1200 rpm, 7.5-kw shaft exciter, 125 v
Spare generator set, 1 ..... Hercules Motors Corp
5 3/4x6-in. cylinder, gasoline or natural gas, 75 kw, 460 v, 1200 rpm
Cooling tower, 1 ..... Marley Co, Inc
15,000 gpm, 6 sections, 6 fans, 9 blades, 17-ft gear reducer
Cooling-tower circulating pumps, 6 ..... Worthington Corp
Vertical, 2500 gpm
Cooling-tower circulating pump drives, 6 ..... Westinghouse Electric Corp
40-hp electric motors, 1767 rpm
Deaerating feedwater heater, 1 ..... Elliott Co
Spray type, 30-psig water pressure, 450-F temperature
Demineralizer ..... Cochrane Corp
Cation exchanger, 20,000 gal; anion exchanger, 80,000 gal
Boiler feed pumps, 4 ..... Pacific Pumps Inc
100 hp, 2x16 in., 102 gpm, 1735-ft head
Condensate pumps, 6 ..... Ingersoll-Rand Co
Vertical, 95 gpm, 3475 rpm
Seal-oil pumps, 6 ..... Geo D Roper Corp
Seal-oil-pump drives, 6 ..... Continental Motors Corp
5 hp, 1730 rpm
Chemical feed pumps ..... Milton Roy Co
Transfer pumps, 2 ..... Allis-Chalmers Manufacturing Co
Utility pumps, 2 ..... Allis-Chalmers Manufacturing Co
Instrument air compressors ..... Chicago Pneumatic Tool Co
Oil purifiers, 2 ..... DeLaval Separator Co
Design, engineering, construction ..... Fish Construction Co



1 Packaged boilers carry the obvious advantages of a fully integrated design. Poor selection of the auxiliaries, the construction materials or the controls may seriously limit your getting the full benefits that this design can bring you

Field Tips Ease Package-Boiler Choice

Compact, quick-assembly benefits of packaged boilers are only the beginning of this boiler design's advantages. Here are selection tips to assure you the low maintenance, easy servicing, high availability the manufacturer builds into the units

By **FRANK F HOHNHOLT**, *Manager*
Packaged Generator Sales
Foster Wheeler Corp

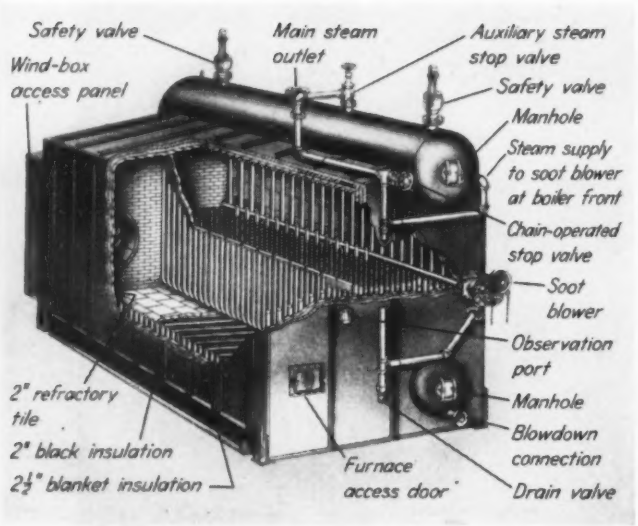
► FULLY INTEGRATED, plant-assembled, packaged, watertube steam generators, Fig. 1, are riding the wave of a demand that's been steadily growing since before World War II. As more and more manufacturers come into the field you can look for a greater number of basic differences in design features. But low maintenance, benefits of easy servicing, and high availability need never and should never be lost.

We find from first-hand dealings with operating and consulting engineers an apparent confusion on several items—items that range from boiler details to proper selection of auxiliaries. When engineers come to evaluate bids with an eye toward low maintenance benefits these confusion points stand out—number of burners per boiler, number of manholes per drum, furnace wall and roof construction baffles in the main boiler-tube bank, hinged burner registers and access doors, soot blowers, 3-valve bypasses at control stations, form of operation and combustion control.

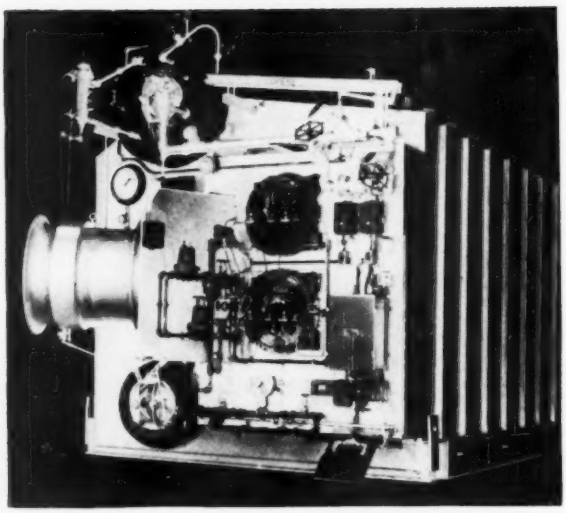
Number of Burners. When you're picking a packaged watertube boiler for industrial service, that is, where you use the steam for process or for conditioning manufactured products, or produce power as well as heating, base the decision on number of burners on the following factors: (1) flexibility or range of firing (2) firing rate (3) uninterrupted steam supply (4) type of fuel slated for the burner (5) combustion control.

When firing fuel oil you'll get the greatest firing range with a mechanical-pressure, steam-assisted atomizing burner. It handles heavy-grade residual fuels in first-rate fashion without undue oil pressure or atomizing steam consumption. Coupled with a fully modulating combustion control, not a high-low or automatic off-on operation, this burner provides firing ranges of 8 to 1.

In addition to firing rate you must consider flame shape, and particularly how it applies to the physical dimensions of the packaged boiler you're buying. Railroad shipping dimensions pretty much regulate packaged boiler height and width. A comparison of the furnaces of several packaged watertube steam generators indicates all have



2 Fan mounting on twin-burner design, above, lets you service fan from floor level, while reducing noise and draft loss



3 Materials of proper type, adequate auxiliaries give a working boiler of high availability, long service life

about the same widths and heights. With such a rigid limitation on furnace width your burner selection ought to be one in which the flame shape does not impinge on boiler side walls.

You can get burners that give a narrow (small included angle) flame cone, but combustion efficiency suffers from poor, ineffective air mixing. Theoretically a 180-degree flame cone is perfect since air supplied behind this flat angle comes in instant contact with the atomized fuel to give complete mixing. The narrower the flame angle, the greater chance for stratification and low CO_2.

With this understanding of oil-burner flame propagation we feel two burners, with relatively short, wide-angle flames rather than a single burner of any design, will give improved combustion efficiency, broader flexibility and less danger of flame impingement for larger-steaming-capacity units (preferably above 20,000 lb per hr).

We know operating engineers who've suffered problems from a loss of steam production when they've changed tips for higher firing rates or replaced dirty atomizers. A fouled burner inevitably shows up at high steam loads. Along this same line, loss of a burner on a single-burner unit because of unforeseen accidents means shutdown. A 2-burner selection, Fig. 2, avoids this.

Manholes. While we're on the subject of servicing, let's look at the selection points for manholes. In all instances, packaged steam generators are longitudinal designs ranging in length from 8 to 23 ft, depending on boiler capacity. Boilers with two manholes per drum permit ventilating by fans, allow a speed-up in cleaning, inspection or servicing not possible with a single manhole. The small additional cost pays for itself during the equipment life.

Access Doors, Registers. Engineers generally prefer that burner registers be hinged so you can get at register flights and burner-diffusers without removing the windbox mounting. Operating engineers, though, do not like using burner openings as access doors. Field reports show servicing costs run high for units of this type. We suggest hinged registers and refractory-lined doors.

Construction Details. Packaged steam generators are highly competitive. You'll find, as a rule, recognized manufacturers pretty much provide units that give satisfactory operation under normal conditions. We feel, however, that good design requires consideration of conditions beyond normal. Industry shares this feeling and expects a high availability from these packaged boilers. As such we recommend first-quality fire-clay tile as waterwall backing to give safe operation in a tube failure.

Bureau of Yards and Docks, U.S. Navy, covers the above point in its recommendations for military purchases of packaged watertube steam generators in this way: "Refractory behind waterwalls shall be of a quality and construction that, in event of watertube failure, no damage will result to refractory, insulation or casing."

Baffles are another item that may cause confusion when you are selecting packaged boiler. All engineers agree they prefer a unit that produces equal efficiencies without any baffling. Here is why. Draft loss, fan size and connected motor load as well as servicing needs are much less and, what's more, no gas pockets can form.

Soot blowers, to our way of thinking, should be valve-in-head with a chain-operated valve for control from the operating floor in addition to auxiliary steam stop-valves on all connecting piping. Drain valves ought to be supplied so all condensate can be removed before using the soot blowers. If you run into a packaged boiler requiring soot blowers over 18 ft, we suggest use of shorter blowers from both ends.

Valve bypasses, also, are special items that engineers believe should be made a part of every bid. In order of importance they rate these points as most in need of bypass protection: (1) feedwater-regulator control valve (2) fuel-control valve, gas or oil, or combination (3) atomizing-agent control valve. What's more, they prefer that valves be plant assembled, piped and mounted to eliminate field labor. In some instances, as in large-sized valves and piping used for gas or feedwater control, or both, for high-pressure units, they may be plant assembled and removed as an assembled unit for railroad clearances.

Operation. All too often both consultants and operating engineers find form of operation badly confused with form of combustion control. But they are distinct and separate. Operation may be manual, semi-automatic or fully automatic. Combustion control, on the other hand, can be the automatic regulation of the combustion components with any of the choices of operation.

For industrial installations a qualified

Check List for Selecting Packaged Watertube Boilers

Automatic vs Semiautomatic

Here are Q&A on choosing operating type:

Q 1: Is there a heating load needing operating pressure at 15 psig or lower on week ends with no engineer in attendance?
A: Yes. Use fully automatic.

Q 2: What is load type? Will wide operating range (about 8 to 1) prove best?
A: Yes. Use semiautomatic.

Q 3: Is an engineer in attendance?
A: Yes. Use semiautomatic.

Q 4: Will peak boiler load reach or go above 20,000 lb per hr?
A: Yes. Use semiautomatic.

Q 5: Would it pay to avoid boiler shutdown through burner accident or fouled tips by having more than one burner?
A: Yes. Use semiautomatic.

Q 6: Is load a representative industrial one —that is, above 15 psig?
A: Yes. Use semiautomatic.

Q 7: Is load intermittent, with periods of little or no steam requirements, maximum capacity below 20,000 lb per hr with boiler room left unattended for considerable periods?
A: Yes. Use fully automatic.

Auxiliaries and Construction

Refractory, insulation should be top grade. Ask supplier for detailed list of materials for each specific wall.

Forced-draft fans should have reasonable safety factors and overload capacities. Look for type designation of fan, motor rating, volume and static pressure data to guard against large connected motor loads, excessive draft losses.

Valves, fitttings, trim cannot all be the same material. See that the boiler manufacturer states size, type, catalog number and manufacturer when listing valves. Thus you avoid bronze or cast-iron selections where their service may be questionable, as in the feedwater line.

Soot blowers. Check closely so you know whether you're getting valve-in-head or revolving designs. See, too, that soot-blower head material, cast iron or steel, is definitely specified.

Instruments, panels can stand a word of caution. Be sure you get the basic instruments of draft gage, steam flowmeter, flue-gas temperature indicator, steam pressure, inlet fuel pressure and temperature gages. Study all extras fairly close as to whether their advantage outweighs their maintenance.

---

operating engineer is practically mandatory. Controls cannot take the place of a competent engineer. They are meant to produce efficient operation at minimum cost under various load conditions. Even though package units carry automatic devices to start, purge, recycle with automatic restart, and so on, you still need a good operator.

With possibly one exception watertube and firetube packaged-boiler manufacturers employ rotary-cup burners, approved by the Underwriters' Laboratories, Factory Mutual, and similar agencies. Boiler units, not including approved firing equipment, when designed for automatic stop and start have to be examined and approved at the installation point. Control systems that do not bear type approval must employ component parts passed by the Underwriters' Labs or Factory Mutual.

Steam generators, with capacities up to 20,000 lb per hr, working pressures up to a 300-psig maximum, and with a single rotary-cup burner approved by Underwriters' Laboratories, usually operate fully automatic with full combustion control.

This fuel combustion control, usually electrically run, supplies these functions: ignition, purge, preignition trial run, low fire start, flame-failure protection, shutdown on override pressure, recycle and start, operation at any pressure at or below design pressure.

This last operating factor at reduced pressure is an important one. Small plants working at high pressures for the normal 5-day run find a fully automatic-controlled unit capable of lower-pressure service highly desirable for week-end heating loads. Many states, in fact, with this form of equipment permit lower pressure, heating service (below 15 psig) without an attending operating engineer. But you can't use a burner where steam at 50 psi serves as the atomizing medium for pressure duty below 50 psi.

Semi-automatic combustion controls work well on fully-automatic-operated, packaged steam generators with these characteristics: (1) all capacities within listed limits of packaged designs (2) pressures limited only by the unit design (3) initial start-up by manual means. For best results you want the burners, single or multiple, to have wide-range controls (about 8 to 1) so the boiler can run continuously without frequent stops and starts, and accompanying heating and cooling losses. Further, you get best results with a fully modulating control with an inertia stabilizer. This form of modulating control has a responsiveness and sensitivity that can't be matched by less expensive high-low, on-off controls, occasionally designated improperly as modulating equipment.

The semi-automatic unit just described provides all similar features of an automatically operated-and-controlled steam generator except automatic ignition and recycling (restarting). But you do get the advantages of greater over-all efficiencies, lower maintenance and higher availability.

Ignition. The fully automatically controlled-and-operated boiler (up to about 20,000-lb-per-hr capacity) has to have an automatic ignition as part of the basic purging and low fire start.

For the industrial installation, though, employing semi-automatic units there is a choice of ignition methods—a torch of saturated waste, a gas torch, a manually operated gas-electric ignition tied into a flame-failure circuit.

The inexpensive saturated waste torches, in use for years, work well enough, except they do dirty up the firing aisle. A gas torch does a similar job in a much cleaner way.

The manually operated gas-electric ignition system, with its electrical interlocking to a flame-failure safety circuit, has become increasingly popular. During starting cycles an automatic time or foot-treadle switch holds the flame-failure circuit open while the transformer and gas solenoid valve of the gas-electric system stays energized.

The combustion controls on these semi-automatic designs may be actuated by electric, pneumatic or hydraulic means. They may be modulating-positioning or modulating-metering. Properly arranged, all forms give equivalent performance. Some systems offer a combination of electric-pneumatic or electric-hydraulic, and employ the electricity for the safety-protection phase.

The pneumatic or hydraulic energy is said to prevent shutdown during power failure. In this event the operating engineer takes over the safety phase.

We feel electric power failures constitute so minor a risk that we would prefer to have our electric-protection circuit function as it is meant to, that is, to complete boiler shutdown. A portable, standby gasoline-driven single-phase 60-cycle generator provides enough low-cost energy to serve combustion controls in rare power failures.

Superpressures: The Next Step to Top Efficiency

Using pressures above the critical makes steam behave differently. The usual boiling process disappears completely. Here's a quick run-down on steam facts and figures

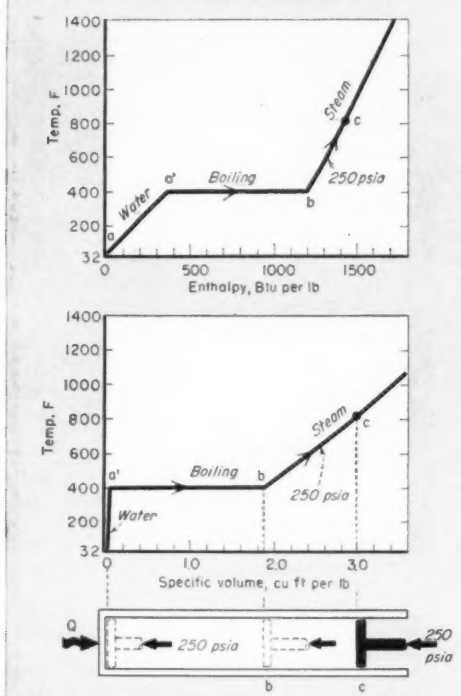
By B G A SKROTZKI, *Associate Editor*

► RECENT ANNOUNCEMENTS reveal we're at the start of a great stride forward in power-plant conditions—a move into the region far above the critical pressure. For years our attention centered on the steady advance of throttle temperature. Now the focus shifts to pressure—to a region about which most of us are somewhat hazy.

So we believe most engineers will welcome a refresher on the physics and thermodynamics of steam at pressures above the critical. On the first two pages, we review the behavior of one pound of water as it's heated under constant pressure. On the next two pages, we study the action of steam in different cycle layouts and compare thermal efficiencies and other characteristics. On the last two, there are preliminary details of a projected steam plant to run at superpressure, together with an outline of some of the problems being studied.

In the continuing struggle to hold down power cost in spite of rising fuel prices we naturally look for ways of improving thermal efficiency. We well know, however, that this usually means using more complicated equipment in the power plant. Often this entails greater investment and consequent carrying charges. So the fuel saving we realize by using more efficient apparatus is partly offset by the additional financial burden. In any event, to achieve our aim, the total production and investment charges against a kwhr must be reduced. That this has been consistently done in the past is the greatest tribute to the genius of our power-plant design engineers.

Here's how one pound of



Big Volume Marks Low Pressure

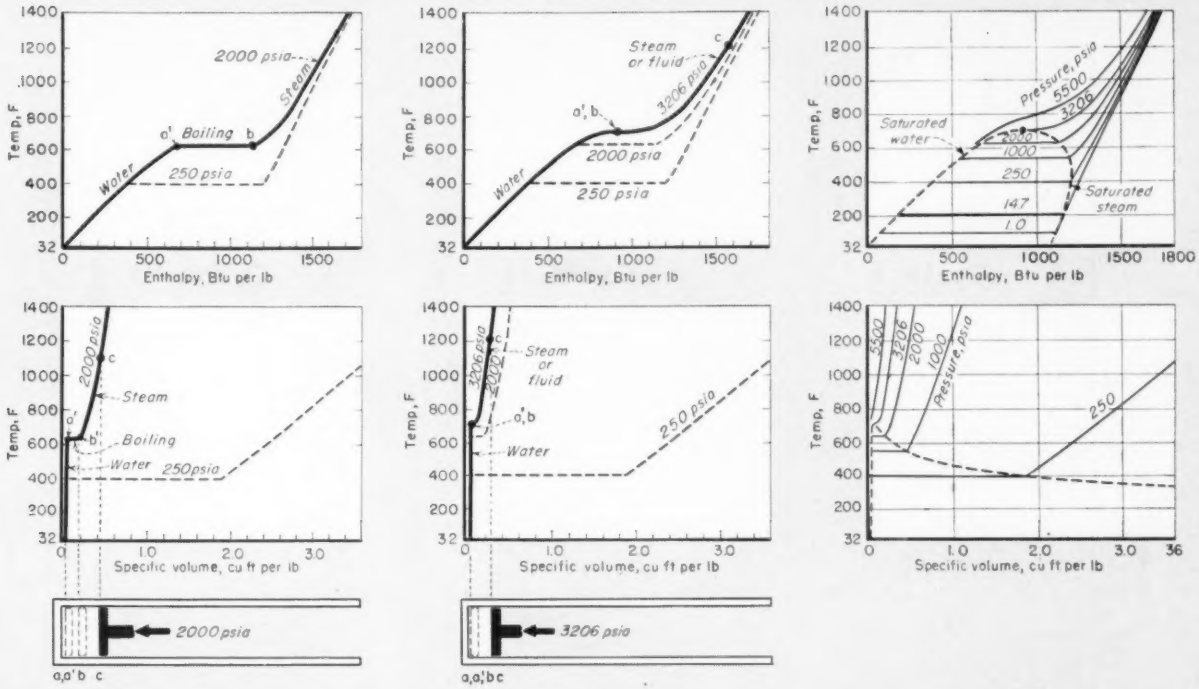
Let's pour one pound of 32-F water in our cylinder and put a total pressure of 250 psi on the piston. That places the piston at *a*. Now we'll heat the water and find it expands very slightly to *a'*, while its temperature goes up to 400.95 F as shown above in the lower graph. The upper graph shows that we have put in 375.2 Btu of heat, which is the enthalpy of the water.

As we heat beyond this point, boiling begins and the volume increases greatly to *b*, while the temperature stays constant. We also find that we have put in a great deal of heat to boil off the water to steam, as shown in the upper graph, 825.1 Btu.

After all the water has changed to steam, the volume continues increasing on further heating, and the temperature again increases. We call this superheating. The upper graph shows us that for each Btu put into the superheated steam we get a greater temperature rise than for an equal amount put into the water.

If we could look into our cylinder during the boiling process, we would see water covering the lower part. In the water small steam bubbles form, which rise and break through the water surface to join the steam filling the upper part of the cylinder. Steam formation causes large volume increase.

water behaves as it is heated to steam at different constant pressures



Pressure Rise Ups Temperature

Starting again with one pound of 32-F water, let's now load our piston to develop a pressure of 2000 psia. As we heat the water it again expands very slightly while its temperature rises, the pressure staying constant. The water becomes saturated at 635.82 F. Upper graph shows we have put in 665.7 Btu of heat to bring it to the boiling point, compared to 375.2 Btu at 250 psia.

Heating the saturated water to boil it off to steam, we find that the volume expands by only 0.1621 cu ft, compared to 1.8251 cu ft at 250 psia. Comparing the total heat input from 32 F, it has required 1129.1 Btu to form saturated steam at 2000 psia and 1200.3 Btu at 250 psia—not very different even though the volumes differ greatly.

Adding heat to the saturated steam, we superheat it as shown by the rising temperature. Getting up into the high-temperature range we find that the enthalpy is not greatly different at the different pressures. For instance, at 1200 F, 2000-psia steam has 1596.1 Btu per lb while 250-psia steam has 1632.7 Btu.

The heat or enthalpy of vaporization for water has decreased markedly for the higher pressure. It is only 463.4 Btu for the 2000-psia steam, but 825.1 Btu for 250-psia steam, nearly double.

No Boiling at Critical Pressure

Now let us really load our piston by applying the critical pressure of 3206.2 psia. We start heating our 32-F water and again the volume increases slightly while the temperature rises. As we reach a temperature around 680 F the rate of volume increase rises slightly till we reach the critical temperature of 705.4 F. After that, the volume-increase rate drops off somewhat with the temperature still rising.

At the critical pressure we didn't get any volume increase at a constant temperature. Looking at the heat-input graph above, we find a point of inflection in the 3206.2-psia pressure curve, but no horizontal, constant-temperature boiling process. In other words, the boiling or evaporation process has disappeared.

Just what does this mean? We start off with a fluid we recognize as water at moderate room temperatures. As it is heated, molecules of the water keep expanding the space they need to maintain a constant pressure. Finally, we get to temperatures at which we know the fluid acts like steam or a vapor. At no time does a water level or meniscus appear. Neither do we see any formation of steam bubbles. As we heat the water it simply keeps expanding in a smooth manner until it becomes steam.

Water or Steam Above Critical?

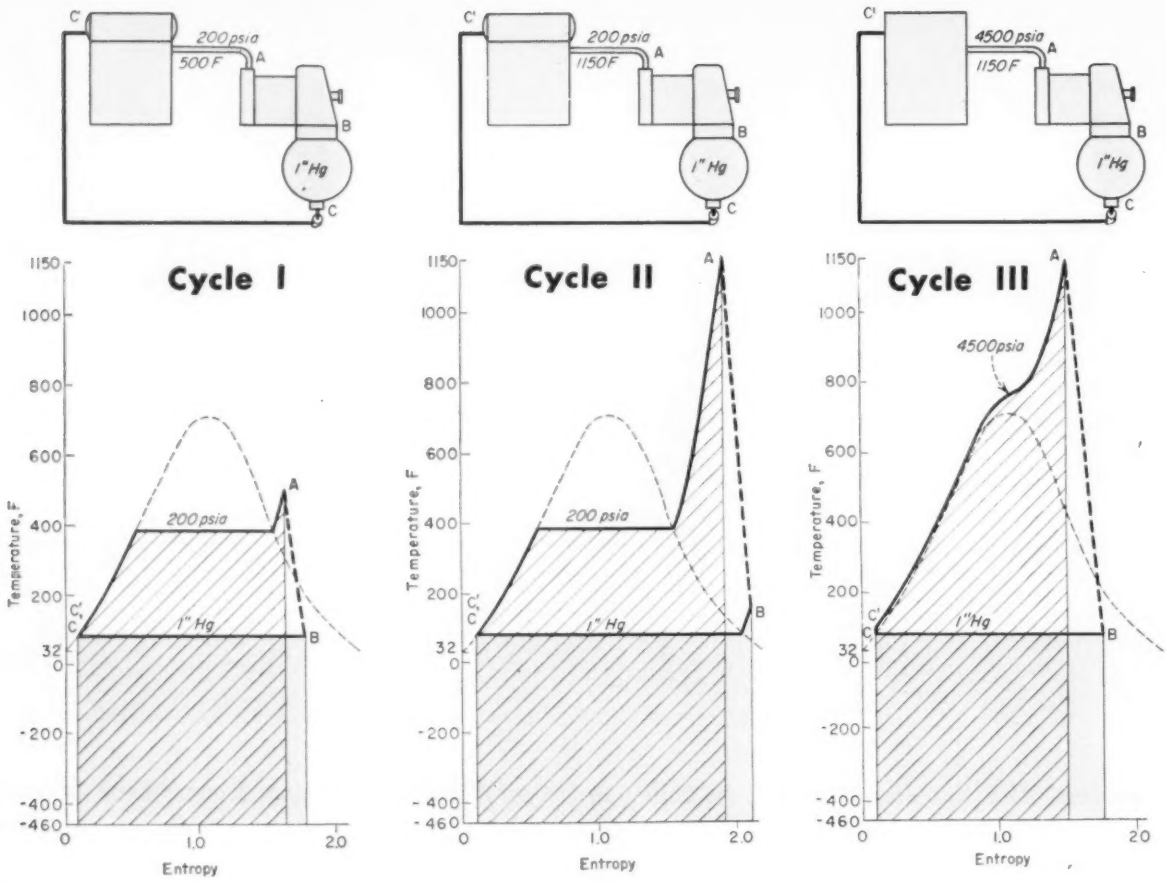
At superpressures it's a matter of arbitrary definition whether we call the fluid water or steam. We could adopt the rule that at temperatures above the critical we call the fluid steam, while below, it's water. The graphs above summarize H_2O behavior at many states.

The experiment below demonstrates the disappearance of water level because water and steam densities become equal at superpressures.

THE DISAPPEARING WATER LEVEL!

Temperature, F	327.8	695.4	705.4
Pressure, psia	100	3000	3206.2
Vapor density, lb per cu ft	0.2257	11.66	19.88
Water density, lb per cu ft	56.4	28.92	19.88

Heating water and its vapor, sealed in quartz tube, raises the pressure and temperature. Water level becomes indistinct, disappears at critical point



How Temperature, Pressure, Heaters, Single and Double Reheating Sway Cycles

How can we work toward developing a highly efficient plant? By adopting all known principles that conserve energy.

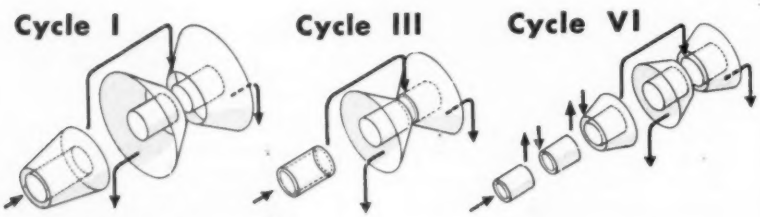
Cycle I. Let's start off in Cycle I, above, with a simple Rankine cycle working at 200 psia, 500 F, 1 in. Hg. On the temperature-entropy diagram the hatched area under *AC'* measures the heat input to the steam. Line *AB* traces steam expansion through the turbine at 80% engine efficiency. Shaded area under *BC* measures the heat rejected in the condenser. Difference in the hatched and shaded areas measures the energy output of one pound of steam.

Table I summarizes important performance characteristics of this cycle and the other five to follow, assuming a boiler efficiency of 85% and uniform turbine *engine efficiency* of 80%.

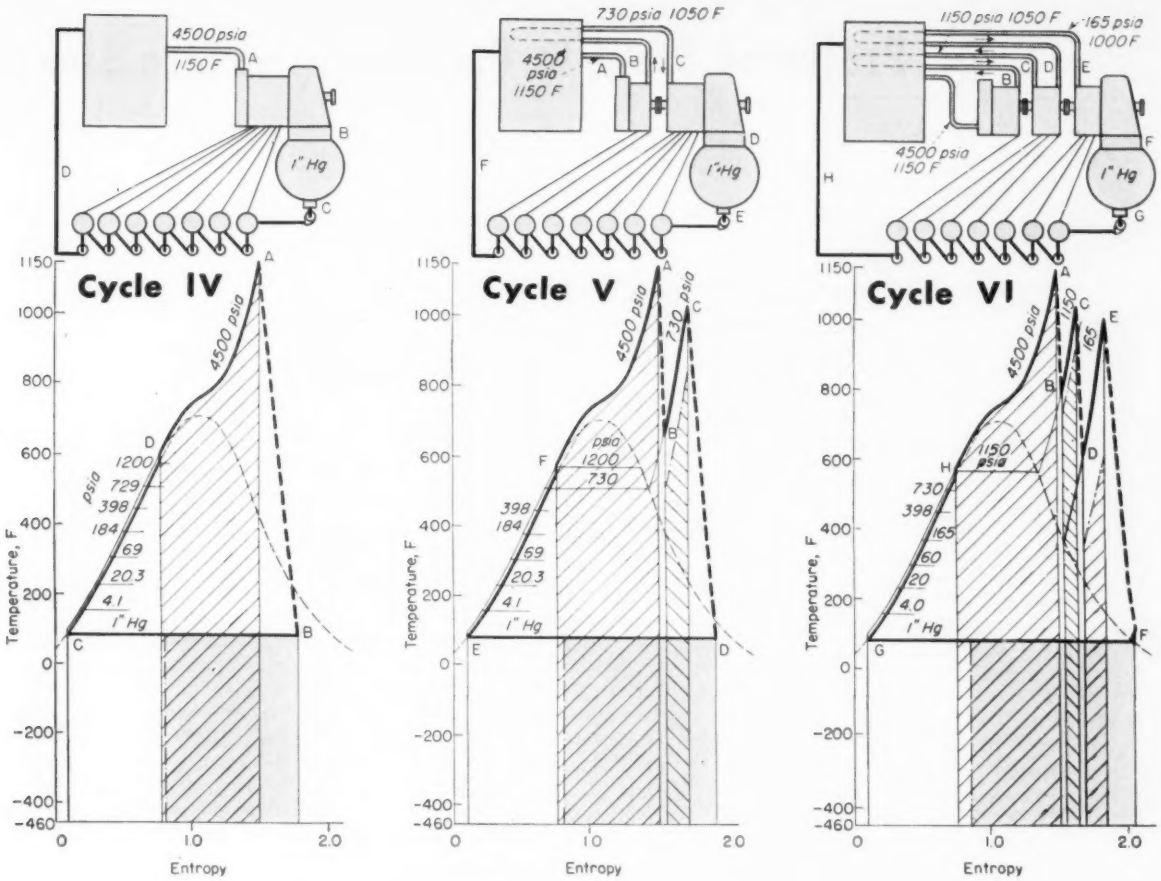
In Cycle II we raise the steam temperature to 1150 F. This improves the performance in all respects. But note that the front end of the turbine has to be larger because of larger steam volume rate. The exhaust steam to condenser is superheated, but despite this the condenser is smaller.

In Cycle III let's raise the pressure to 4500 psia, keeping temperature at 1150 F. Again we achieve a great gain in efficiency and other characteristics. Note the phenomenal reduction in volume rates at the turbine throttle and condenser inlet. Moisture in the turbine exhaust is at the maximum tolerable level of 14.3%.

In Cycle IV we add seven regenerative feedwater heaters. This reduces the input area to the hatched one under the line *AD* for one pound of steam. The heat rejected by one pound steam in the condenser is the area under *BC*, but since less than one pound steam reaches



TURBINE STEAM-PATH size for given capacity shrinks with more efficient cycles



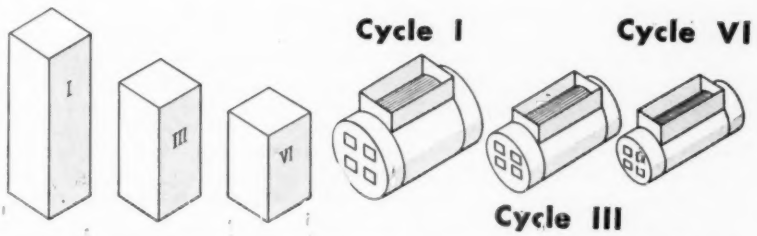
the condenser for each pound entering the throttle, the shaded area is scaled down accordingly. The difference in areas measures the output for one pound steam entering the throttle.

In Cycle V we add one stage of reheating at 730 psia back to 1050 F. This achieves additional gains in all respects, as shown in Table I. The area under *BC* measures the reheat input to one lb of steam, but since some of the steam is bled for feed heating, less than one pound goes through the reheater for each pound entering the throttle. Hence, the area is reduced accordingly to the hatched one to indicate the amount of reheat for each pound of steam at the throttle. Sum of the hatched areas, less the shaded area, measures the net output of the cycle per pound of steam entering the throttle.

Cycle VI uses two stages of reheating, the first at 1150 psia to 1050 F, and the second at 165 psia to 1000 F. This scheme gives us another performance improvement all around: efficiency, steam rate and volume rates. The exhaust steam to the condenser is slightly superheated.

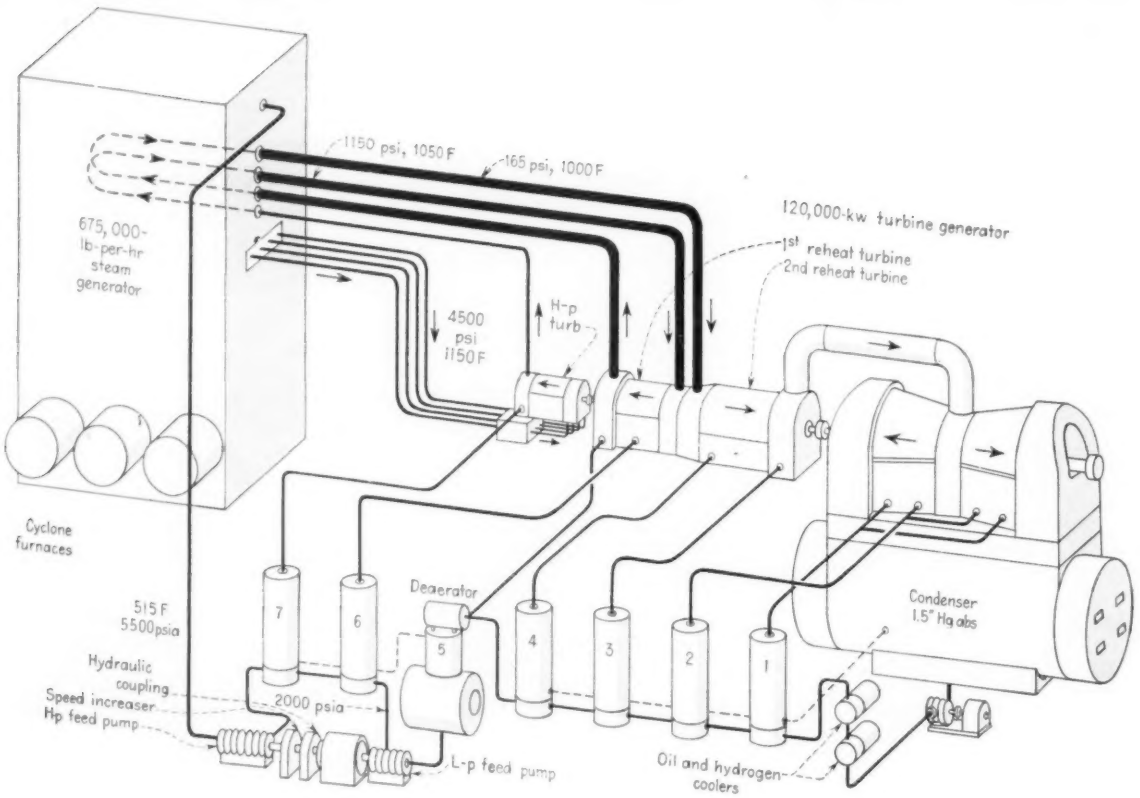
Table I—Comparison of Cycle Performance

Cycle	I	II	III	IV	V	VI
Plant thermal efficiency, %	22.03	25.68	31.60	37.37	38.75	39.70
Plant heat rate, Btu per kwhr	15,500	13,300	10,800	9,135	8,810	8,600
Plant throttle-steam rate, lb per kwhr	10.78	7.25	6.35	8.43	6.79	5.95
Plant condenser-steam rate, lb per kwhr	10.78	7.25	6.35	4.84	4.04	3.63
Throttle steam-volume rate, cf per kwhr	29.38	34.53	1.156	1.534	1.236	1.084
1st reheat steam-volume rate, cf per kwhr	—	—	—	—	6.81	4.09
2nd reheat steam-volume rate, cf per kwhr	—	—	—	—	—	22.8
Condenser steam-volume rate, cf per kwhr	6132	5490	3570	2720	2483	2450
Condenser heat rejection, Btu per kwhr	9740	6665	5710	4350	4020	3845
Exhaust steam moisture or superheat	13.7%	87F	14.3%	14.3%	5.2%	22F
Feed pump work, % of plant net output	0.25	0.17	4.10	5.44	4.37	3.83



FURNACE VOLUME, *left,* and condenser size also shrink with more efficient cycles

Projected Plant to Use Superpressure Steam



Station Heat Balance ...

Preliminary details of a new unit incorporating the advantages of very high steam pressures and temperatures were revealed recently by Philip Sporn, President, American Gas and Electric Service Corp, in an article in *Electrical World*, June 29, 1953, p 72-6. The new 120,000-kw unit will replace Unit No. 1 (40,000 kw, reheat) at the Philo Station of the Ohio Power Co. This unit was installed in 1924.

POWER's dimetric schematic sketch, above, shows the preliminary heat-balance arrangement being considered as a basis for design. It conforms closely to Cycle VI, which we were talking about on the preceding page. The plant will use double reheating. Steam conditions at the throttle and two reheat inlets are (1) 4500 psig, 1150 F (2) 1150 psig, 1050 F and (3) 165 psig, 1000 F.

New Features. The throttle pressure is just about double the highest steam pressure now being used in a few plants. This factor leads to adopting small-diameter tubing at the high end of the cycle to develop needed strength with an economy of materials.

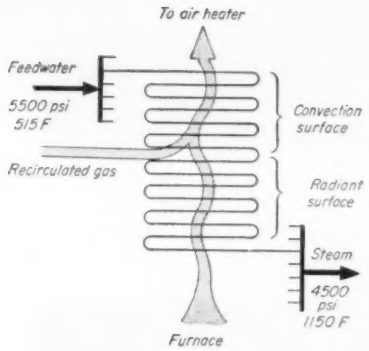
The supercritical steam pressure means elimination of conventional boiler designs. The steam generator needs no drums because boiling is not involved. The unit utilizes the once-through principle of heating.

The once-through feature, and utilization of cyclone furnaces, is expected to result in a very compact steam generator. Head room needed should be unusually low. The 1150-F throttle temperature demands using austenitic materials at the outlet end of the steam-generator tubing, steam leads, and front end of the h-p turbine. This temperature is 50 F above the highest now being used.

The 5500-psig feedwater pressure requires a new design of pump, perhaps new pump arrangement. Water conditioning and control of solids in the steam generator, turbine and other parts of the cycle will have to be watched carefully. There will probably be new concepts developed in the field of feedwater treatment.

Seven stages of feedwater heating reflect the great economy of the regenerative cycle with the high heat head used in this plant. Highest number of heaters used in a few modern plants today is eight. Deaeration will be performed in the fifth heater using 175-psig bleed steam from the main turbine.

While superior performance is achieved at the expense of more complicated equipment, this is offset by the smaller over-all size of the steam generator, turbine and condenser. The sketches, *lower left and right pp* 82 *and* 83, show relative sizes for Cycles I, III and VI as higher steam conditions and more complicated cycles are used.



Steam Generator ...

... called a Universal Pressure steam generator, will be built by Babcock & Wilcox Co. This will be the first time it is used in this country commercially. Although made up of many tubes connected in parallel, the unit acts as one single long tube. It takes in 5500-psig water at one end. Continuous heating expands the water as it travels through the tubing till it emerges as 4500-psig, 1150-F steam. There is no boiling. The 1000-psi pressure drop through the steam generator assures uniform distribution of water in the parallel tubes.

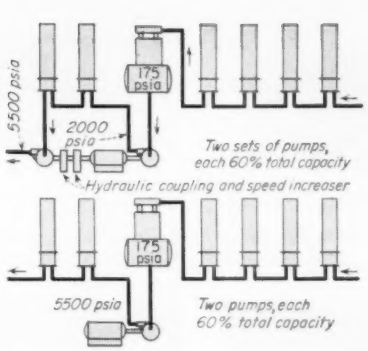
The entire h-p side of the steam generator must be made up of small-diameter tubing of considerable thickness. The composition varies with the temperature, carbon steel at the feedwater-inlet end, and stainless steel at the high-temperature steam-outlet end.

Three cyclone furnaces will burn crushed coal to fire this unit. Gas leaving the primary furnace will be cooled to 1900 F before entering the convection surfaces. Recirculated flue gas will be the coolant. This will prevent slagging of the convection surfaces.

Gas leaving the convection passes goes to a tubular-type air heater, the induced-draft fans and the stack. Part of the gas is recirculated before entering the air heater. No dust removal equipment will be installed.

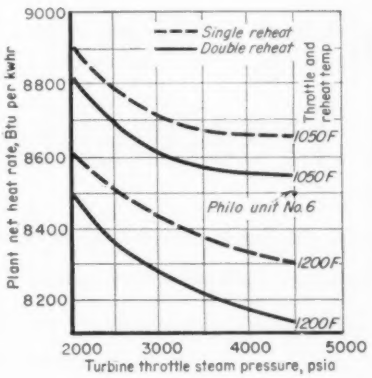
Discharge pressure of the feed pumps controls the steam-generator pressure. In turn, a pressure regulator at the turbine throttle controls the pump speed. The main steam flow and temperature will control the firing rate. Dampers in the gas passes will control steam temperatures at the two reheat points.

To take care of starting and transient conditions recirculating valves with breakdown orifices will pass fluid to the deaerator from the steam generator. The deaerator, in turn, passes saturated steam to condenser.



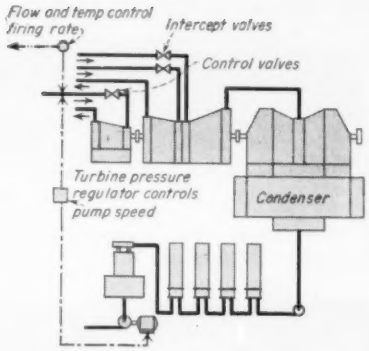
Feedwater System ...

... may use one of two schemes shown above. First scheme uses conventional barrel-type pumps at constant speed to develop 2000 psia through last two heaters. Variable-speed h-p pumps boost water out of last heater to 5500 psia. Each of two pump sets will have single-motor drive. Second scheme uses two pumps in parallel under deaerator to raise pressure directly to 5500 psia for flow through last two heaters of new design for these high pressures.



Performance ...

... depends a great deal on the steam conditions used in a steam plant. At 1050 F, with either single or double reheat, little gain in efficiency can be obtained at pressures above 4000 psig. Boosting the temperatures to 1200 F keeps efficiency rising with pressure increase to about 7000 psig. Philo Unit No. 6 is expected to run at 8500 Btu per kwhr. This is an over-all thermal efficiency of 40.1%, highest to be attained so far.



Turbine-Generator...

... to be built by General Electric Co will be a single-shaft machine running at 3600 rpm. A special h-p turbine in tandem with reheat turbines of the reverse-flow type and a double-flow l-p turbine make up the unit.

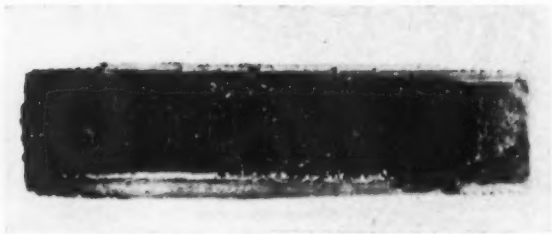
Steam at 4500 psi, 1150 F from the steam generator will pass through four steam leads to four pairs of stop and control valves at the front of the turbine. The throttling control valves vary steam pressure to the first stage of the h-p turbine. Intercept valves in each of the hot reheat lines will protect the turbine from overspeeding in event of a tripout.

Stop and control valves, steam leads, flanges and part of the inner shell of the h-p turbine will be made of austenitic materials. GE is now studying the rotor to see whether it may be made of ferritic materials with steam cooling, or whether the high-temperature parts must be made of more costly austenitic materials.

The h-p element will be of double-shell construction; the low-temperature parts of the inner shell and all the outer shell and fittings are to be of ferritic materials. From the first reheat point to the condenser the turbine will be built entirely of ferritic materials.

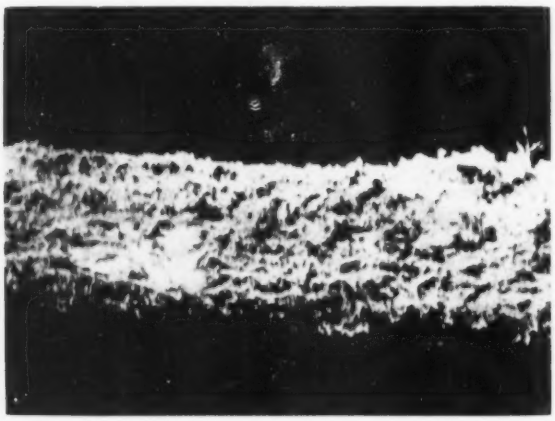
Two sets of reheat stop and intercept valves must be provided. A special initial temperature regulator will sense the steam temperature at the turbine throttle and will close the control valves if the temperature drops either too low or too fast. This will protect both the steam generator and the turbine by preventing a condition like water carryover should the fire be lost. The protection scheme is similar to that given by an initial-pressure regulator on a conventional boiler.

Because of limited cooling-water availability, and to use existing tunnels, the main condenser will be of 2-pass design. It must be completely tight.



1 Metal left to itself corrodes rapidly, and scales up in cooling-water systems to upset smooth plant operation

2 Immediate, good treatment lays down a thin protective scale, which is scarcely visible, to safeguard the metal



3 Wood in cooling towers, handling constantly reaerated water, suffers from concentrated salts that are left behind

4 Resins leach out from the wood, material softens and fiber frays as these concentrated sodium salts go to work

Recirculating-Water Systems Need Expert Treatment Supervision

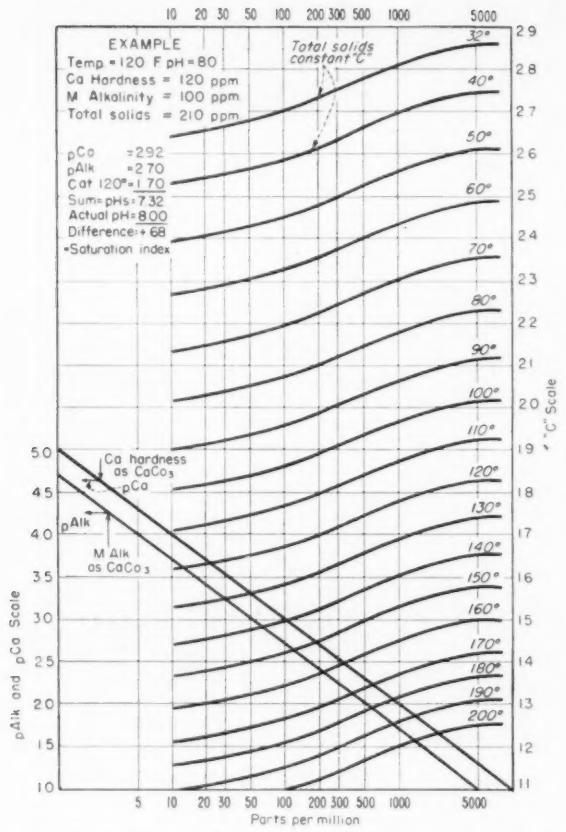
For industry's needs, cooling-water supplies have had to come from much-used streams, falling-water tables. Then, when recirculated again and again, it's prone to scale, foster algae, become corrosive. Here's some practical help on the problem

By **SHEPPARD T POWELL**, *Chemical Engineer*

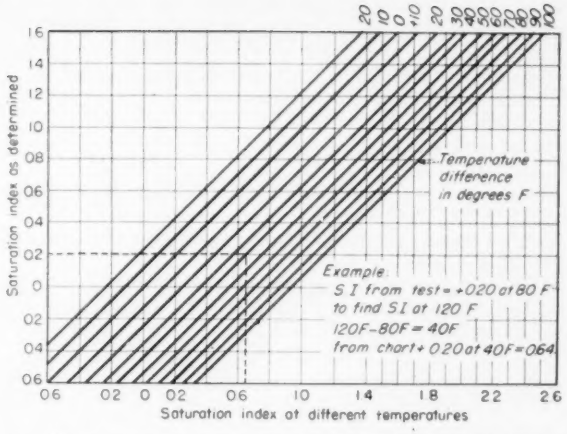
► SCALE FORMATION and corrosion represent the two chief problems in cooling-water operations. Scale, by itself, comes readily under control with proper water treatment. But its presence complicates the corrosion problem. And with today's heavy use of cooling-purpose water, emphasis is on corrosion control in these low-temperature piping systems.

The old once-through cooling system, still prevalent in small plants, just pushes the water through its cooling duties and then dumps it to waste. It's a system that has the twin merits of low equipment cost and only the slightest scale and corrosion headaches. But so much water is needed for the job it does that operating costs become prohibitive. As a direct result, water recirculating systems, like the one in Fig. 7, serve most of industry's wants.

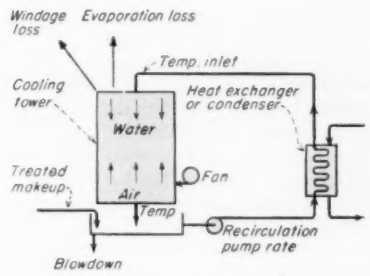
The open system of water recirculation, Fig. 7, employs spray ponds or cooling towers to release the heat picked up by the circulating water. These sprays or cooling towers sacrifice a part of the water by evaporation to the atmosphere to effect the cooling action. In doing this, though, they make an active problem of corrosion by (1) building up the concentrations of the scale-forming solids in the water left behind (2) introducing the corrosive agents of oxygen and carbon dioxide. Add to this the possibility that micro-organisms may be present in the water to influence the choice of corrective water treatment, and you begin to appreciate the job's



5 Basic Langelier Saturation Index lets you predict whether your cooling water has any corrosive or scaling tendencies


Saturation index as determined
Temperature difference in degrees F
Example
S I from test = +.020 at 80 F
to find SI at 120 F
120F-80F = 40F
from chart + 0.20 at 40F = 064
Saturation index at different temperatures

6 Where operating temperature makes it hard to lay down a scale, heat water for a short while according to the chart



7 Principal elements of a typical open recirculating system are shown above

complexity, and the room for the score of treatment methods now common.

Basically, however, you can reduce corrosion to a safe rate by control of pH and dissolved solids alone. But actually you need a thorough knowledge of your circulating-water analysis and its behavior in the recirculating system. Protecting any metal from corrosion by water depends on conditioning the supply to correct its corrosive characteristics or creating and maintaining a physical dam between the anodic and cathodic part of metal surface and water.

Protective Coating. How do you go about getting this protection? One way is to put on a protective coating using organic or inorganic materials, or both. Also, you may lay down a deposit as a product of cathodic or anodic corrosion reactions, or as a precipitate from the liquid on all areas. In any case, the deposit should be nonporous and continuous if it is to give complete protection.

Water treatment can guard against corrosion provided some steps, like deaeration, are taken to remove any gases that form. For instance, a thin, impervious, adherent deposit of calcium carbonate scale can be laid down by regulating and adjusting pH, alkalinity and calcium ions. This scale is a good general inhibitor against corrosion. It covers both anodic and cathodic areas.

There are a few natural waters, such as those of the Great Lakes, that meet the requirements for laying down a proper calcium carbonate scale. Most waters need treatment to bring about the desired state of equilibrium for the calcium carbonate in solution. Fortunately, Professor W F Langelier[1] pioneered in developing the idea of a calculated saturation index as a means of predicting the corrosive or scaling effect of a natural water. His idea has been so advanced that its use is widely accepted.

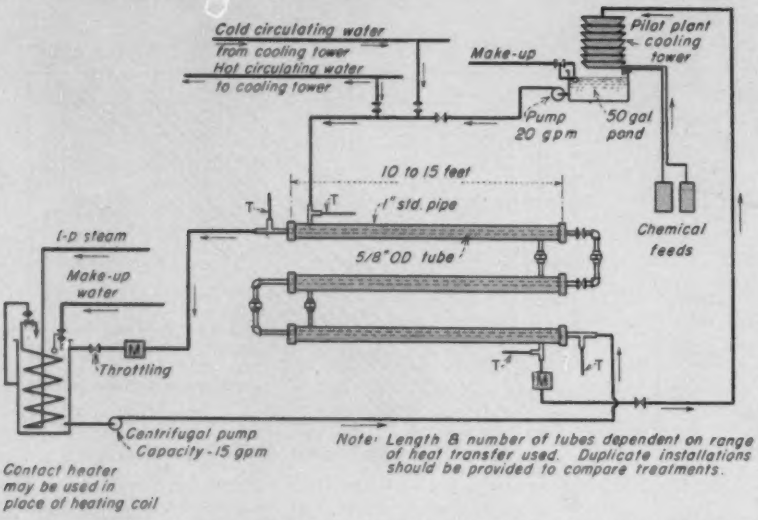
Because most natural water carries dissolved calcium and magnesium in the form of bicarbonate and noncarbonate hardness (chlorides and sulfates mainly) there is a tendency for that water when heated or made more alkaline to deposit a scale or corrosively attack the metal. But there are also sodium salts, dissolved carbon dioxide, oxygen and other gases in the water. Just which way the water goes—that is, to lay down a protective scale or attack the metal—depends on how this dissolved material balances out.

If the various forms of carbon dioxide (free CO_2, bicarbonate and carbonate) are at equilibrium, they cause neither scale nor corrosion. The surest way of judging the state of the water, corrosive or not, and the steps that will correct it, is to determine the solubility equilibrium relations of calcium carbonate. The Langelier Saturation Index chart, Fig. 5, is a convenient way of doing this.

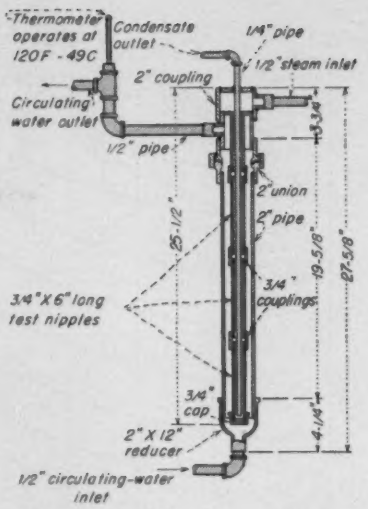
Langelier chart makes use of logarithmic expressions of calcium hardness, methyl orange alkalinity and a factor for temperature and total solids. (Temperature accelerates corrosion or scale-deposit formation, whichever way the water tends to go.) If you know the value of calcium hardness, alkalinity and total solids, you pick off the chart the information to figure out the saturation pH (*pHs*) and the saturation index.

(*Continued on page* 88)

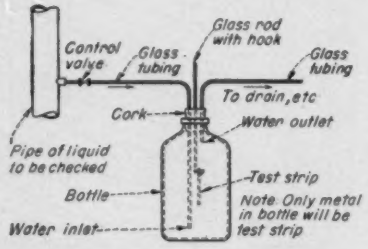
[1]Langelier, W F, "The Analytic Control of Anti-Corrosion Water Treatment," *Journal, American Water Works Assn.* 28: 1950 (1936).


Cold circulating water from cooling tower
Hot circulating water to cooling tower
Make-up
Pilot plant cooling tower
Pump 20 gpm
50 gal pond
10 to 15 feet
1" std. pipe
Chemical feeds
5/8" OD tube
l-p steam
Make-up water
Throttling
Centrifugal pump Capacity - 15 gpm
Contact heater may be used in place of heating coil
Note: Length & number of tubes dependent on range of heat transfer used. Duplicate installations should be provided to compare treatments.

8 Control of how good a protective scale you are getting comes from a system of miniature heat exchangers that let you study the rate and type of the deposits



9 Test unit checks scale and corrosive tendencies at points in water system



10 Permanent test unit piped into line for continuous measurement sample

All you have to handle is two equations: $pHs = pCa + pAlk + C$ where pHs is saturation pH; pCa is log factor of the calcium hardness, and $pAlk$, the log factor of M alkalinity, both expressed in ppm of equivalent $CaCO_3$. C is the log factor of total solids in ppm at the water's temperature. The second equation states that Is (saturation index) equals the difference between actual pH and saturation pH (pHs) calculated: $Is = pH$ (actual) $- pHs$ (calculated).

With Is zero, $pH = pHs$ and the water is at saturation equilibrium. If Is is positive, that is pH (actual) is more than pHs (calculated), a super-saturation of $CaCO_3$ exists and a protective scale will deposit out. The opposite holds if Is is negative. Then pHs (calculated) exceeds pH (actual) and a corrosive attack will occur on the metal.

The desired Is runs between plus 0.6 to 1.0, or higher if inhibiting substances are in the water.

Let's work out an example, with a deepwell makeup water of 80 F, a calcium hardness of 80 ppm, an M alkalinity of 196 ppm, a pH of 7.5, and a total solids of 352 ppm. In it we'll use a cooling tower, Fig. 7, as a part of the circulating-water system. Here dissolved solids concentrate because of evaporation.

Start on the parts per million scale at the bottom of the chart, Fig. 5, at the calcium hardness reading of 80 for the makeup water, and go straight up to the slanted line labeled Ca hardness as $CaCO_3$. From this point move left to read on the $pAlk$ and pCa scale the reading 3.10. You follow the same procedure for the M alkalinity reading of 196 ppm except that you stop at the first slanted line labeled $pAlk$. On left-hand side of chart, read 2.41.

Now go back to the ppm scale at bottom of chart, and start out with 392 for total solids. From this starting place run straight up to the 80-F temperature line, and then on the right-hand "C" scale read off the figure 2.13. Sum of these figures just tallied gives the pHs reading of 7.64. With this sum being greater than the pH (actual) of 7.5 by 0.14, the saturation index is positive and the water is corrosive.

Data for the circulating water are picked off the same way. From table p 87 on the Langelier chart, Fig. 5, this circulating water has a plus saturation index and could be expected to deposit scale. But it would deposit too much. If sulfuric acid were added in the right amount, the alkalinity could be cut down to give a methyl orange reading of 80 ppm corresponding to a $pAlk$ of 2.82. As a result the saturation index would be down to a recommended plus 0.62.

Often it is desirable to add the sulfuric acid to the makeup rather than the circulating water to get a plus 0.6 saturation index in the circulating water. You do it by controlling the methyl orange alkalinity of the makeup water to no more than 62 ppm, corresponding to a $pAlk$ of 2.91 so $pCa + pAlk + C = 7.40$.

When inhibitors are present in water the Calculated Langelier Index indicates a higher scaling value than is actually so, and you have to make a so-called modified marble test for your basic data.

Scale Inhibitors. Once you get a water with a plus saturation index you still may not be able to lay down the thin, dense, hard scale so desirable. And the reason is the water may be of such a condition it contains factors that inhibit scale formation. Chief of these are: (1) organic inhibitors that disperse calcium (They retard precipitation, prevent crystalline scale formation.) (2) high sodium alkalinity or other solids (They sometimes tend to increase the solubility of calcium ions.) (3) oil on the metal surfaces (4) algae and slime (5) excess phosphates.

These factors work against the ideal thin, uniform scale formation in many ways. One is to lay down so much scale that an objectionable loss occurs in heat transfer. This is particularly noticeable where organic slimes form, or algae develops. Wherever algae growth is prolific you have to chlorinate, or you'll find control of the calcium carbonate scale hard to get. For phosphates, particularly metaphosphate, the scale deposit proves too porous to be effective against corrosion attack.

Because high sodium alkalinity has an inhibiting effect, use lime to adjust the water's alkaline content rather than

caustic soda when you want to raise the saturation index. Or you may, where part of the makeup is softened, bypass the raw water to adjust the alkaline content. Further, where caustic is used, the temperature coefficient of scale sometimes proves objectionably high and it gives porous and bulky deposits. What's more, manipulating the "scaling force" or "descaling force" of the water by varying the calcium content requires smaller adjustments than you get by varying the sodium alkalinity.

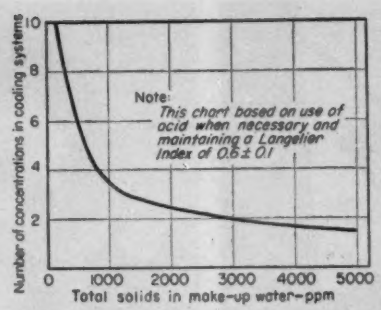
Protection Examples. Remember, it pays to lay down a protective scale rapidly before corrosion occurs. If you clean equipment, especially by acids, the metal tends to corrode rapidly. A high scaling index established immediately will prevent the initial attack.

Where outside conditions like operating temperature make it difficult to scale equipment, heat circulating water with steam or hot water until a good protective scale is laid down. Fig. 6 lets you pick off the saturation index to work to at the heated temperature against the normal operating temperature where you probably would make your test.

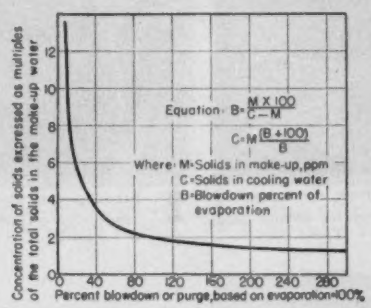
Fig. 1 shows a poor example of scale formation. No treatment of any kind was used for the first few weeks. Corrosion took place. Finally a treatment of lime and soda ash was set up to hold the saturation index near plus 1. No scale formed and corrosion seemed to go right on. A high-rate chlorination was started and the inhibiting effect of organic matter overcome. Then a protective scale was laid down as long as a positive chlorine residual was maintained. But the severe tuberculation produced by corrosion shows under this scale. Fig. 2, on the other hand, shows the result of immediate, good treatment. The scale here is closely adherent to the tube and can hardly be seen. Some of the best protective scales don't show too clearly when wet. A drop of HCl is the only way of proving its presence because the carbonate effervesces as the CO_2 boils off.

Control Measures. What control procedures should you follow to get the ideal protection in the usual cooling system? First thing is to set up routine water testing, following up by adjustments of the treating chemicals.

Most satisfactory control comes from a system of miniature heat exchangers, Fig. 8. Here rate and type of deposit accumulations can be studied and adjustments made on the basis of experience. With such a pilot plant, inlet and outlet temperatures as well as cooling-water velocity should duplicate the actual ones. Cool off the circulating water in the pilot plant in an open-type cooler so it is continuously reaerated,



11 Estimated allowable concentrations of makeup water in cooling towers



12 Blowdown needed for holding cooling-tower water solids in check

as happens in your plant in the cooling tower. This gives the test water the same aggressiveness as the full-scale plant water.

Fig. 9 is a test unit designed for checking the scale or corrosive tendency of cooling water at various points in the plant system. It consists of (1) an outer shell made from 2-in. pipe, an inner shell that is the test surface for inspection made up from ¾-in. pipe and (2) a number of convenient-length nipples. Inside the inner shell is a ¼-in. condensate outlet pipe. Cooling water enters the bottom of the outer shell and discharges near the top. Steam for heating enters at the top and flows down the inside of the inner shell. Condensate is discharged to waste as recovered. The unit can be easily dismantled to inspect the inner shell's surface after a test run.

This test unit gives control over cooling-water flow into it as well as heating steam so outlet temperature of cooling water corresponds to discharge temperature of the equipment you want to study.

Fig. 10 is helpful where it is advantageous to (1) observe rate of attack without dismantling the applications or (2) determine loss of metal weight.

Special Inhibitors. How about treatment based on some one of the many corrosion inhibitors on the market? Experience varies all over the lot with some successes and some failures reported. Following is a brief roundup of some of these special materials.

Chromates and Dichromates (highly hazardous to handle): These ions react with ferrous ions released at anodic areas to form a mixture of ferric and chromic hydroxides as a tough, adherent, self-sealing scale over anodic areas.

Consumption of chromate is in direct proportion to rate of corrosion. Once complete coverage of the anodic area is maintained through a proper concentration, consumption of chromate by the inhibiting reaction can be zero. Only loss is due to windage or blowdown at the cooling tower. Unless losses run high, maintain chromate around 300 to 500 ppm for complete protection. Effective pH range is from 7.5 to 9.5. It is preferable to maintain a zero or negative index to avoid scale formation. No scale is necessary since the chromate film serves as a physical dam and prevents contact with metal surface and water.

As temperature goes up or high electrolyte concentrations increase (notably chlorides), chromate concentration has to be raised.

Quachron Glucosate is a proprietary compound containing four chromate groups and incorporating the glucose structure (relatively high cost). Several others use chromates, organic compounds and alkalies, or all three. Presumably chromium enters into the anodic inhibiting reaction as it does when used in the form of inorganic chromates. The attached organic molecule is said to make the film elastic, and greater in area per unit of chromate.

Concentrations recommended for inhibition run about a tenth as great as required when sodium salts are used. Titrations for chromate content are the controls. Because of cost, system has to be closely bottled, losses reduced to a small amount. With proper concentrations, treatment is highly effective.

Metaphosphates. "Threshold treatment," as it is called, involving holding concentrations of metaphosphates at a point just too low to combine with all calcium present, has been used successfully in boiler water for scale prevention. More recently it has been used to hold iron in solution and prevent corrosion. Municipal plants use it to prevent "red water." A discernible film of iron metaphosphate deposits on the metal surface (presumably at anodic areas where the ferrous iron is released) and this inhibits corrosion.

For circulating cooling-water systems this treatment works best with a pH below 7.0. The failure to meet the low

(*Continued on page* 200)

1 First step in making pipe model is to draw an isometric sketch of piping, as author does here, to fix model size

2 Brazing operation in construction of model. Cold-rolled steel rod is joined with a low-temperature brazing alloy

How Model Tests Cut Piping Design and

Use of scale models to predetermine stress conditions in high-temperature piping assures economic design, good performance of modern power plants

By JOHN F O'ROURKE, Mechanical Engineer, The M W Kellogg Co

► RECENT TRENDS toward higher pressures and temperatures in power-plant installations have increased the importance of adequate engineering for thermal expansion. Proper design and layout of piping is essential for satisfactory service performance. Inadequate analysis in this respect has resulted in the shutdown of entire plants due to fatigue failure of piping or distortion of connected equipment.

Mathematical analysis of the expansion stresses and reactions is broadly covered by the General Analytical Method presented by The M W Kellogg Co in *Design of Piping Systems*, 1941. In employing this method, the solution of up to 18 simultaneous equations, which represent, in general, a system of four points of fixation, can be handled effectively. With an increase in the number of fixed ends or intermediate restraints, the mathematical approach becomes extremely laborious and time-consuming. The model test solution of piping systems has been evolved to solve problems too intricate for calculation or those where the mathematical solution is not economically feasible.

Model tests have additional appeal to designers of high-temperature piping in that they permit visual evidence of the interaction of all members in the system. Addition of guides or changes in configuration can be made directly on the model, and results from alternate tests readily obtained. Since alloy-piping costs are a significant item in high-pressure plants, the model tests can be used with considerable economic advantage toward the elimination of excess piping.

Model tests have been conducted for hundreds of power, petroleum and chemical plants, and for marine installations for the United States and British Navies. Most recently, they have been employed for atomic-power plant design.

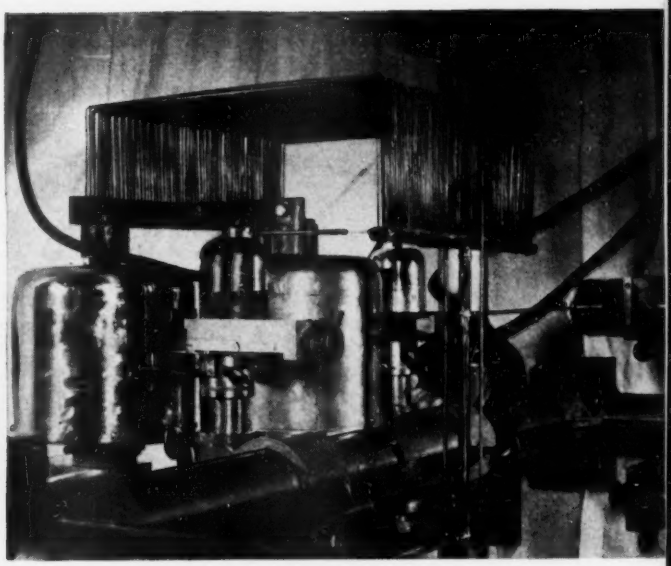
Principle utilized in the model test method is that of displacing the ends of the model-simulated pipeline with relation to an assumed fixed point, and measuring the end reactions created by this springing of the model. Displacements applied are a percentage of the calculated free thermal expansion of the ends from the fixed point, including the expansion of connecting equipment. The forces and moments at the ends of the model are proportional to those occurring in the actual pipeline when brought up to operating temperature.

Model Construction. Solid cold-rolled steel rods, Fig. 2, are used in building the model. They are bent to shape cold, and are brazed together. Model ends are silver-soldered in 1-in.-square steel blocks having tapped holes to facilitate fastening to the measuring units. The length scale used for the model depends on the dimensions of the testing apparatus and its arrangement. Most models come within a range of ½-in.=1 ft to 1 in.=1 ft, though some tests have been run on full-scale models of short connecting lines where operating conditions were critical.

Where the system has the same size pipe throughout, any rod diameter from ⅛ through ½ in. is used. If two or more pipe sizes are used in the actual system, their stiffness ratio is incorporated in the model. This is done by obtaining a product of the moment of inertia and the modulus of elasticity of the actual pipe and choosing rods in this relation.

Valves or similarly stiff members are represented in the

3 Assembly of elements in boiler superheater model. The rod elements are silver soldered to insure complete fixation



4 Closeup of model showing superheater-element section of main steam piping attached to electrical measuring units

Fabrication Costs

model by solid steel blocks or other heavy sections. In recent years it has been a practice to include the terminal elements of the superheater as part of the piping to increase the over-all flexibility of the system. These complicated tube arrangements are reproduced by bending drill rod of correct stiffness to represent the tubes running to the header from the point of exit through the boiler arch, Fig. 3 and 4.

Test apparatus consists of an adjustable tubular framework for supporting the displacement units, which apply movements to the ends of the model. Machined tubular-steel posts extend from floor to ceiling of the test room, Fig. 6. To these parts, tubular arms may be attached to give access to any point within a 7-foot radius. The arms are splined to receive the micrometer displacement units.

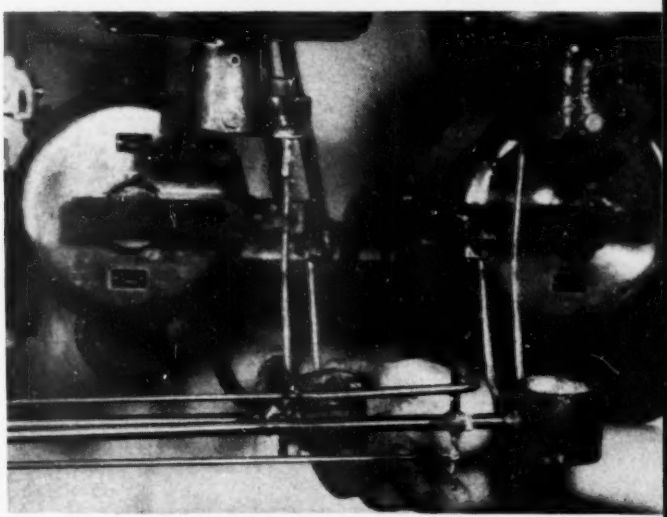
The displacement units combine three mutually perpendicular slides, each operated by a micrometer lead screw with a thimble graduated in thousandths of an inch.

The slideways are hand-scraped to avoid any possibility of undesired motions during application of the displacements. Slides are locked in position after movements have been made.

The electrical measuring units resolve the force and moment at each end of the model and measure the three coordinate components of each. This combined action is accomplished by applying the force and moment, by means of a three-dimensional cross, through six cantilevers aligned with the three coordinate planes.

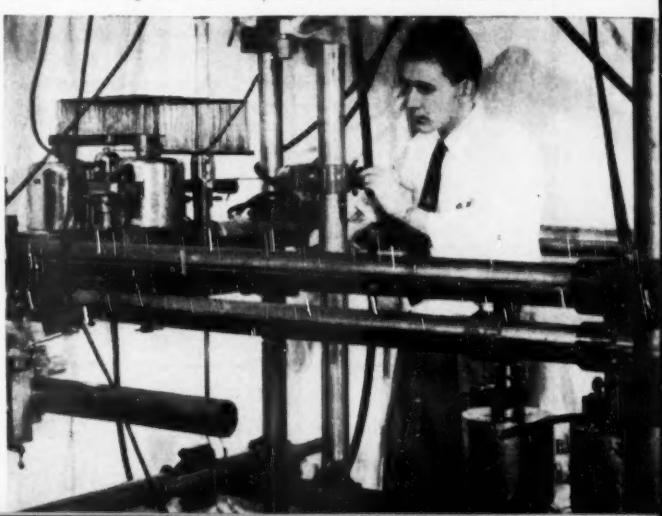
Six pairs of strain gages are cemented to the cantilevers. Gage resistance varies in proportion to the cantilever deflection. Thus, by measuring the change in resistance of the various strain gages, the component forces and moments may be found. Each pair of gages is permanently wired into a wheatstone bridge circuit. A self-balancing potentiometer, Fig. 7, gives the readings directly in hundredths of a pound.

(*Continued on page* 92)



5 Turbine leads from main steam piping attached to electrical measuring units for determining system end reactions

6 General view of model test apparatus showing main steam line running from the superheater to turbine-lead takeoff



Test Performance. When the model is set up in the test apparatus, an initial reading is taken on all strain gages in the electrical units attached to the model ends. The displacements are then applied and a second reading taken on all the gages. The magnitude of the maximum displacement is chosen small enough to prevent the model from yielding.

Displacing the model ends sets up forces and moments at the end connections. Differences between the initial and stressed readings are the loads on the cantilevers, from which the forces and moments are determined. Scale factors are used to convert the model readings to full-scale pipe readings. The moments thus obtained may be transferred mathematically to critical positions on the pipe and the maximum stress calculated.

Deflections of spring supports in a piping system can also be measured directly on the model. An initial reading is taken at the required point on the model by a dial gage. This gage is fitted with a knife-edge contact that closes an electric circuit when it touches the model.

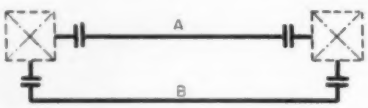
After the displacements are applied, the dial gage is again screwed up until it makes contact and closes the circuit. The difference between the two readings is the movement of that point on the model. The deflection is converted to full scale and corrected for the line expansion. Deflections obtained by the model test method have been verified by field results.

7 Loads on end connections of model are read directly from this self-balancing potentiometer, are recorded on form

Principles of Flexibility

The purpose of flexibility in a piping system is to prevent excessive stresses in the pipe and fittings and high end reactions on the connecting equipment. But a system cannot be too flexible because the cost is higher and there is an increase in pressure drop in the pipeline.

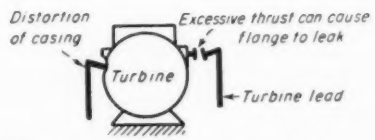
Pipe stresses vary directly with the operating temperature, coefficient of expansion, modulus of elasticity and size of the pipe. Stress varies inversely with length of run between terminal connections. Forces and moments vary directly with the wall thickness of the pipe. Thus, you can see that all these factors must be taken into consideration in design.



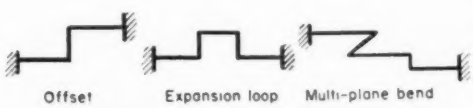
LINE A is too stiff; valves are highly stressed
LINE B is flexible enough to relieve the valves

UNRESTRAINED LINE expands when temperature is raised. Amount of expansion depends on temperature increase and the coefficient of expansion

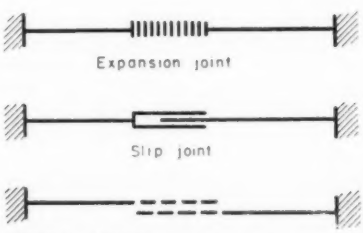
RESTRAINED LINE tries to expand between anchors but is prevented. Result: it flexes as here



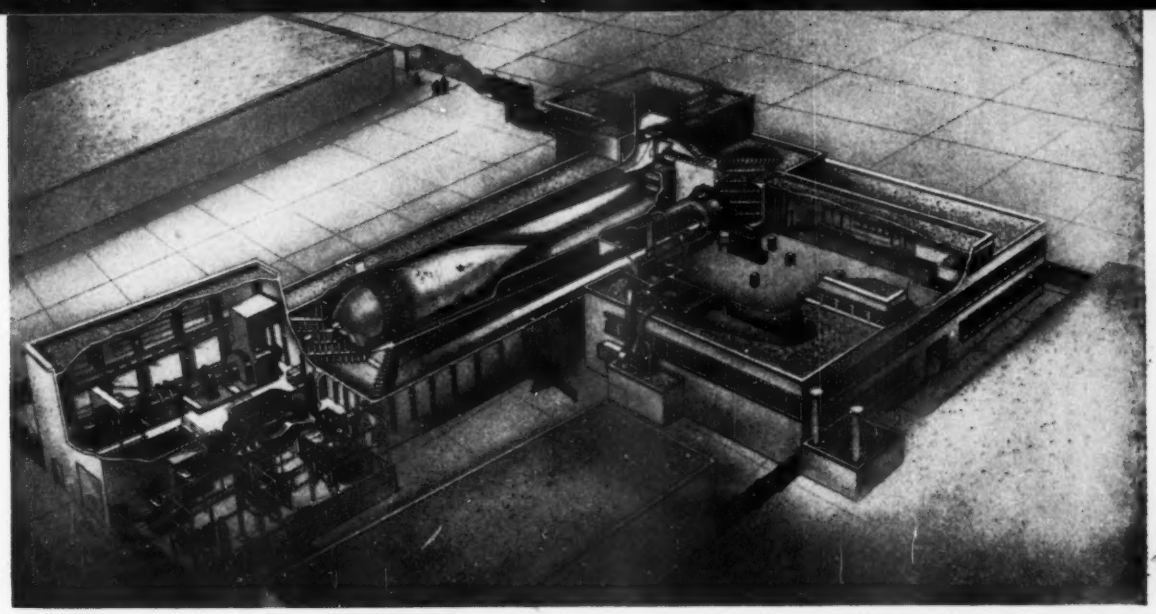
THRUST from the pipe can distort turbine casing or cause the pipe flanges to leak badly. Proper design of piping and turbine leads prevents this



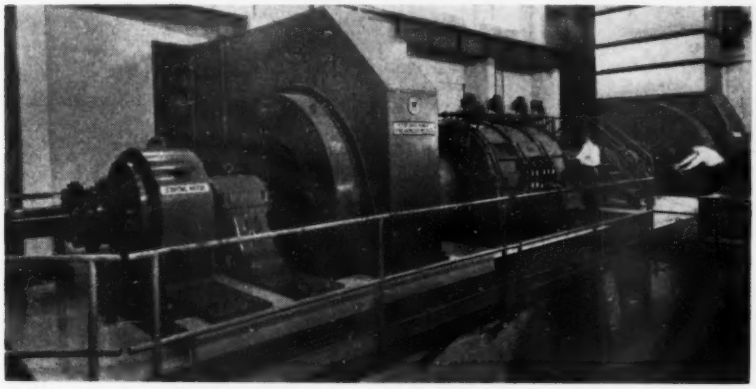
ANY DEPARTURE from a straight-line connection increases the flexibility of the system. This may be an offset, expansion loop or other bend



EXPANSION JOINTS allow pipe to behave as if it has two free ends, *bottom sketch*. On certain jobs they replace pipe bends and loops in system



Wind tunnel at Boeing Airplane Co's Seattle plant is largest privately owned tunnel in U.S. Recently modified, it can produce subsonic, transonic and supersonic speeds. This view shows motor room, 2-stage fan, air passages and test section



Motors develop a total of 54,000 hp. Magnetic clutch joins original 18,000-hp motor, left, with the new 36,000-hp unit, right. Clutch makes the fine adjustments

Two-stage fan has 72 blades, each 3 ft long, forcing air past 18-ft-dia nacelle

Pushing Air With 54,000 Hp

► BOEING AIRPLANE CO'S wind tunnel at Seattle now has 54,000 hp driving its huge 2-stage fan. Recent changes, costing $1.6 million, include coupling a new 36,000-hp motor to an existing 18,000-hp unit. The magnetic clutch that joins the two motors had coupled the original motor to the fan shaft.

Top fan speed is 480 rpm. Up to 100 rpm the original motor, rheostatically controlled, does all the work. At higher speeds the larger motor is cut in. Magnetic clutch makes the fine adjustments. Motors are started in the powerhouse and controlled from a panel close to test-section windows.

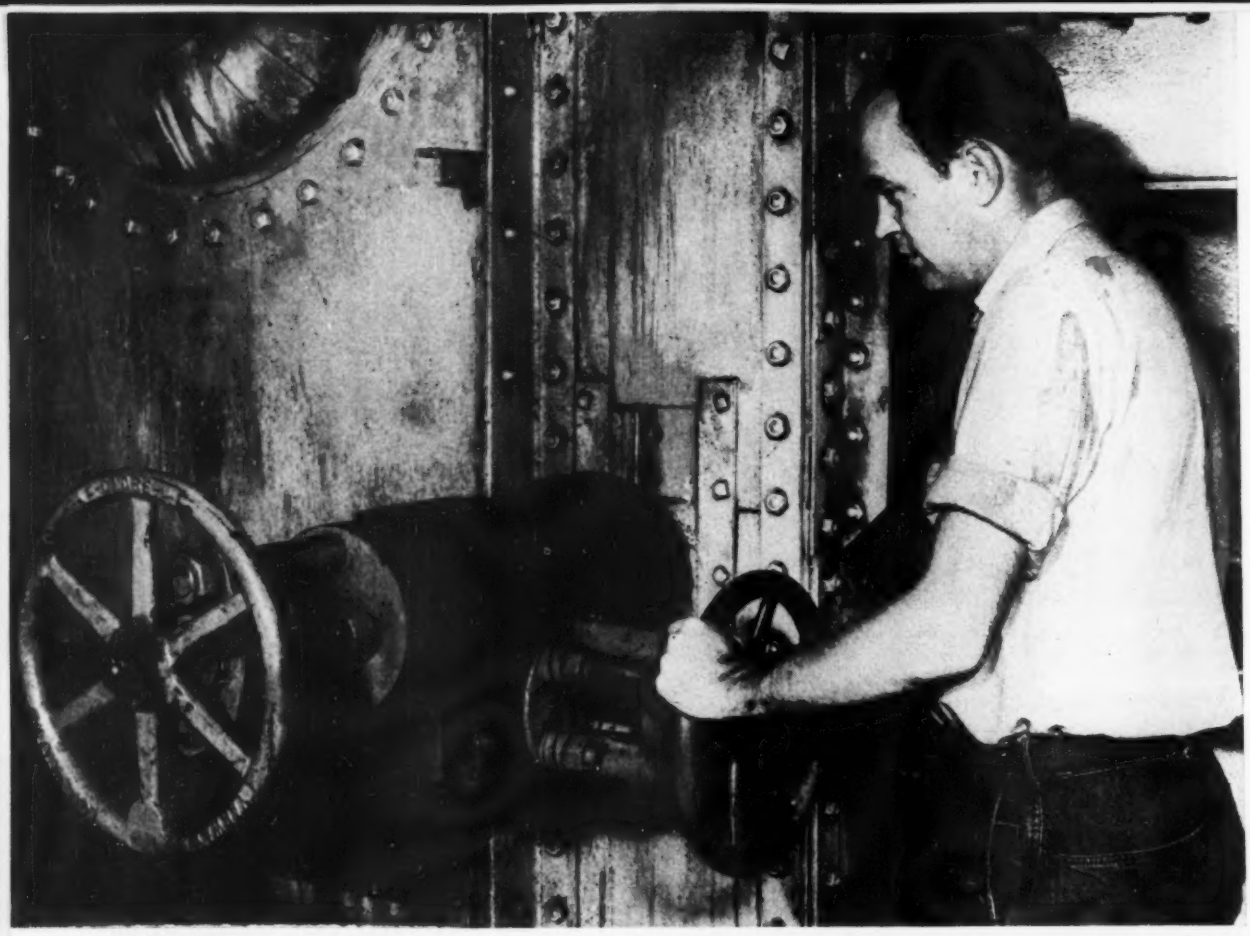
This wind tunnel is the largest privately owned testing facility in the nation. And it is the only privately owned tunnel where research men can study effects of transonic speeds on airplane models. Only three other transonic wind tunnels, all Government-owned, compare in size with the new Boeing tunnel. Test section of this privately owned giant is 8 ft high, 12 ft wide.

In addition to the added power, tunnel has been refitted with a new fan setup, new cooling system, strengthened walls and a new test section.

The fan, with two stages of 3-ft blades describing a 24-ft circle, forces air past an 18-ft diameter teardrop-shaped nacelle that houses the fan hub. The 72 fan blades are made of laminated spruce covered with glass cloth, while the rest of the fan is precision-machined steel and aluminum.

Tunnel is a closed rectangular tube. Since the moving air is heated by friction on the tunnel walls and would reach unsafe temperatures if uncontrolled, layers of fresh air are drawn into the tunnel at the third turn between layers of hot air, and mixed to provide evenly warmed air. Separated ducts and a screen take care of the mixing. A portion of the hot air is scooped off the top and exhausted outside the building.

The air, traveling about 100 mph as it approaches the test section, accelerates rapidly as it enters the confined 8x12-ft space, and can reach speeds higher than that of sound.



UNIT-TANDEM blowoff valve on No. 24 boiler at Philadelphia Electric Co Schuylkill Station. Boiler is 600,000-lb-per-hr unit that operates at 1350 psi, 900 F. This design blowoff valve is manufactured for working steam pressures up to 2500 psi

High-Pressure Boiler Blowoff Valves

To pick the right valve for your new or existing boilers you must consider pressure rating, materials, trim, size, number, type and installation. Here are topnotch selection methods

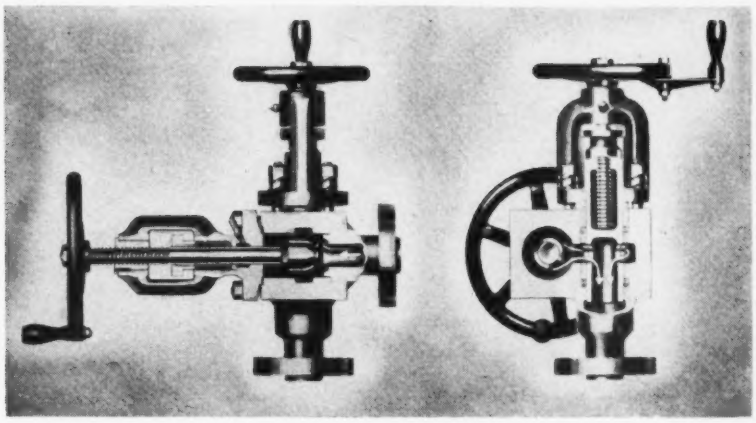
By **E E FINSEL**, *Mechanical Engineer, Yarnall-Waring Co*

► SELECTING suitable blowoff valves for high-pressure boilers is a problem power-plant designers meet every time they plan a new station. Though the boiler manufacturer may standardize his selection for given pressure and temperature ranges, the plant designer must approve the choice. This, in effect, amounts to investigating valve properties the same as though you were selecting from scratch. Let's take a look at important factors arising in blowoff-valve choice today.

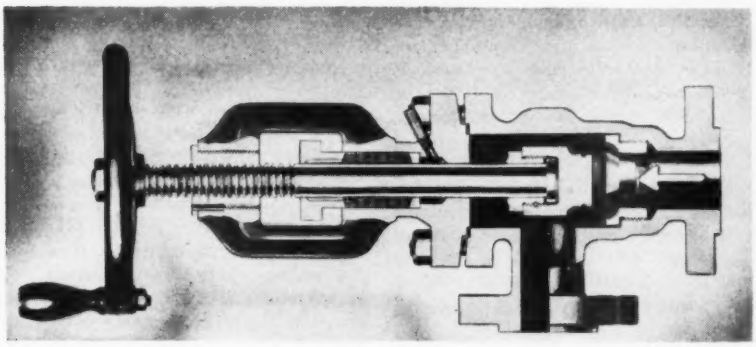
Of vital importance to every designer is selection of boiler auxiliaries that reduce outage time. So he must look at blowoff valves from several angles, including suitability for operating conditions, and amount of maintenance to expect. Shutting down a large boiler to maintain or repair one small valve part is a waste of time and money that should be avoided in the design stage, if at all possible.

Pressure Ratings. ASME Code *Power Boilers* fixes pressure ratings for blowoff valves in high-pressure service. To choose or check a valve properly you must be familiar with Code requirements relating to this service.

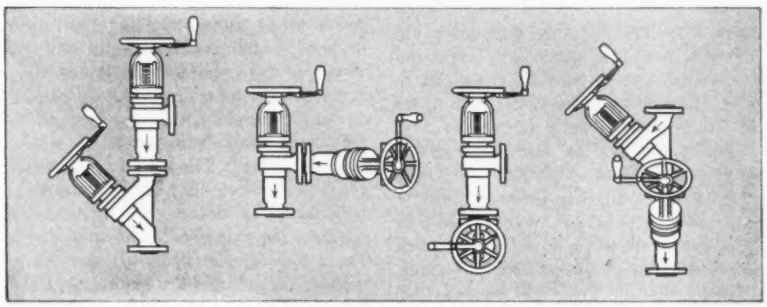
Paragraph P-310c of the Code covers valve pressure ratings. Carbon steel fittings and valves, designed to American Standards Association (ASA) requirements for 150, 300, 400, 600, 900, 1500 or 2500 psi, are limited by the Code to an 80% pressure rating for blowoff or feed-line service. Also, for steel, it is important to know that the



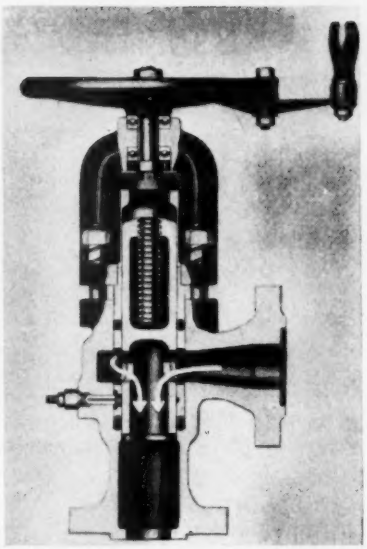
1 Sections through seatless sealing valve, *left*, and the hard-seat blowing valve, *right*, of a unit-tandem blowoff valve. Both valves are in their open positions



2 Hard-seat angle blowoff valve in the open position. This valve is designed for working steam pressures up to 2500 psi, has stellited hard-seat disk and seat



3 Arrangements for seatless tandem valves used at steam pressures up to 600 psi are angle-straightway, straightway-angle, angle-angle, straightway-straightway



4 Seatless sliding-plunger-type blowoff valve for pressures to 1500 psi

ASA primary ratings are for temperatures in the superheat range (800 F with flanged and 850 F with ring-joint or welded connections). Pressure and temperature adjustments must be made *before* computing the 80% value.

To avoid the need for calculations the Boiler Code Committee has set up a table listing adjusted pressure ratings for saturated-steam temperature conditions and the allowable 80% values in blowoff service. For convenience, this is shown in Table I, p 97.

An accurate graphical method for determining the 80% values is shown in Fig. 5, p 96. Here the pressure-temperature curve for saturated steam is plotted along with pressure-temperature curves for certain valve materials. One set of materials curves is for ordinary conditions, the other for 80% pressure ratings, or blowoff and feed-line service. As can be seen, ASA 1500-psi carbon-steel valves with ring-joint or welded connections have a primary temperature rating of 850 F. They may be used to 2500 psi for *saturated-steam* service and to 2080 psi for blowoff service.

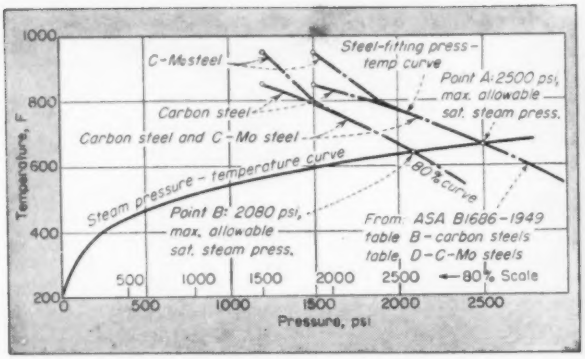
To save time, valve-selection tables usually list the ASA primary pressure rating, such as 1500 psi, and the ASME Code pressure for blowoff service, such as 2080 psi. Saturated-steam rating, in this case 2500 psi, is not ordinarily listed. Table II is a typical example of condensed data on tandem carbon-steel blowoff valves.

Materials. Blowoff valves, like other boiler accessories, have had to keep stride with the rapid advances in pressures and temperatures and the changes in operating procedures. Today, high-pressure boilers are seldom blown down except to correct an emergency condition, like failure of water treatment to properly condition the water.

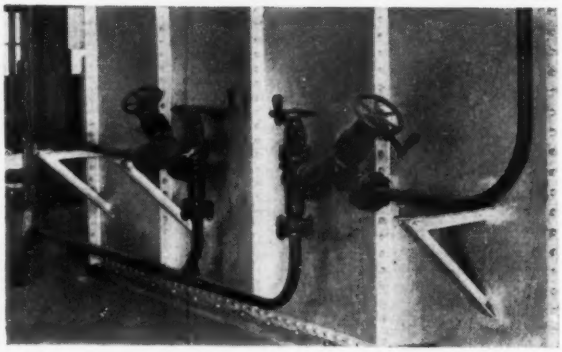
As a result of newer operating conditions we find new materials and improved older materials coming to the fore. Acid cleaning of boilers, a widely used means of reducing down-time, introduces additional problems. Take high pressures, acid from boiler washing, high velocities through valve during blowdown, and wear from precipitated solids—mix well, and you have an extremely tough materials problem to solve.

There is no internal part of a blowoff valve entirely free from effects of the above conditions. That is why body materials rate just as much attention and care in selection as valve seats, stems and other parts.

Table III lists a large number of special materials for valve parts and their resistance to 5% inhibited hydrochloric-acid cleaning solution. On the



5 Blowoff-valve pressure curve based on '49 ASME Code *Power Boilers*. ASA 1500-psi valve with ring joints, welding ends



6 Seatless tandems in a modern plant have spring-supported inlet piping and well-designed discharge run to the drain

BLOWOFF VALVES *continued*

The Right Valve Gives Years of Good Service

basis of these data it is easy to see that some of the materials are far better suited for blowoff valves than others. Where acid cleaning is contemplated, careful attention must be given to trim parts such as valve stem, stuffing-box bushing, disk and nut, valve seat, plunger and glands.

Blowoff valves are not affected by mechanical cleaning if reasonable care is taken. But in acid cleaning, acids are pumped into boiler through blowoff valves at relatively high velocities to reduce the cleaning time. High flow rate increases corrosive action on valve during filling period. Acid discharge again subjects valves to intensified erosive and corrosive action.

Note from Table III that Hastelloys and chrome-nickel stainless steels, especially those containing molybdenum, are resistant to attack. Galvanic contact with low-carbon steel reduces attack on these alloys at the expense of accelerated attack on the steel body.

Beryllium copper and hardenable monels have low resistance when tested individually but are highly resistant when in contact with SAE-1020 steel. But note that with beryllium copper, attack rate on contacting steel is accelerated to four times the rate for steel alone. Compare this to factors of less than two for chrome-nickel stainless steels. These rates deserve serious consideration during selection of trim material used in a steel-valve body.

Practical application of types 316 and 317 stainless steel, as valve-plunger material in steel-boiler blowoff valves subjected to acid washing, is based on many field applications. These confirm test results.

In general, when boiler-cleaning solutions other than inhibited acid are used, materials resistant to hydrochloric acid are resistant to alternate solutions. They may not, however, be the best materials. If corrosion rates are critical, select materials with regard to specific conditions encountered.

Other factors—hardness, resistance to erosion and accelerated corrosion of valve body adjacent to trim material—are equally important in selecting desirable valve-trim materials. When these requirements are especially important, materials with best corrosion resistance may not be the most desirable. Compromise materials may prove best in over-all performance.

Boiler *and* valves should be given same neutralizing and flushing treatment after each acid wash. Failure to take this precaution could result in trapping of cleaning acid in valve cavities, causing corrosion over a long period. Deterioration will exceed that normally anticipated.

Note that the Code requires steel-body blowoff valves for working pressures in excess of 200 psig. Usual valves have either cast- or forged-steel bodies.

Typical Trim. Though materials for high-pressure valve trim may vary from one manufacturer to another, a few examples of standardized trim for valves suitable for acid-wash service will be helpful.

Valves with cone seat and disk, and inlet under seat, Fig. 2, suitable for pressures to 2500 psi, have following trim when built for acid-wash service:

Part	*Material*
Stem and disk nut	#303 stainless steel
Stuffing box, bushing	Ni-resist #3
Disk and seat	Stellited SAE-1020

Seatless valves of the design shown in Fig. 4 have the following trim for acid-wash service:

Plunger	#317 stainless steel
Upper gland	Chrome-plated steel tubing
Lower gland	Ni-resist #3

Where acid wash is not contemplated, the trim for these seatless valves is:

Plunger	Nitralloy
Upper, lower glands	Chrome-plated steel tubing

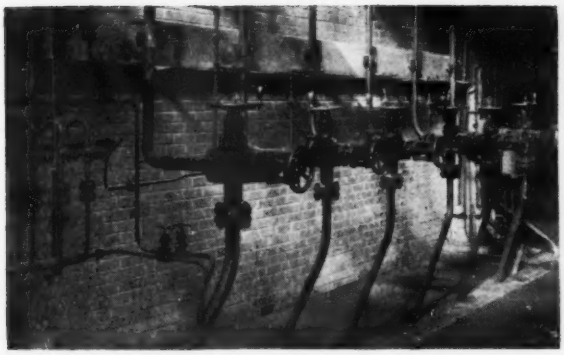
Valve Size. Standard blowoff valves are made in sizes from 1 through 2½ in. Remember, when selecting valve size, the larger a valve, the faster the removal of liquid from the boiler. This is important both during regular blowdown and during acid cleaning. Also, using more than one set of valves permits faster draining after acid cleaning. Velocity of liquid leaving boiler is higher, insuring entrainment and removal of more foreign material.

No matter what size valve is chosen, its walls should be heavy enough to withstand intensified corrosion during acid cleaning. Thick-wall valves are generally classed as heavy-duty type.

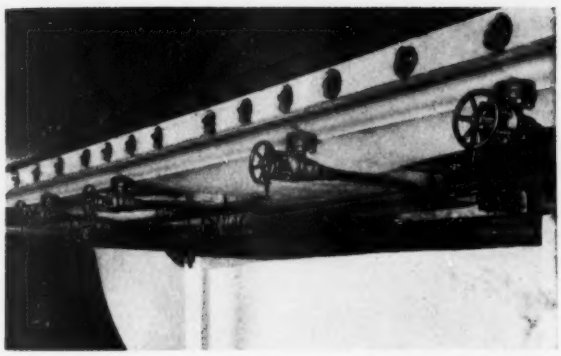
Number of Valves. Accepted codes require two valves in blowoff lines. These may be installed separately or in tandem, Fig. 6 and 7. They are at the bottom of the boiler, usually connected to the lowest header. Generally, more than one blowoff connection is required on a boiler, with two valves used at each connection.

Where the two valves are bolted together, the assembly is known as a tandem and can be arranged in a number of different ways. These include angle-straightway, straightway-angle, angle-angle and straightway-straightway, Fig. 3. Arrangement is based on space conditions existing around boiler and has no relation to operating pressure or temperature.

To save space, interconnecting flanges and bolts and gaskets needed in bolted tandem valves, the design in Fig. 1 was



7 Unit-tandem blowoff valves here are easy to operate and maintain, are piped so there's little chance of errors



8 Seatless and hard-seat valves on waterwall drains of a high-pressure boiler. Note how easy they are to operate

developed. This has a one-piece steel block serving as a common body for both sealing and blowing valves. As can be seen, horizontal inlet valve is cone-seat and disk type; vertical discharge valve is the seatless type resembling that in Fig. 4. This design is usually called a unit-tandem type.

Valves of the unit-tandem design are also built with two hard-seat valves in a common body. This design is particularly adaptable to higher pressures. Unit-tandem types are available with either flanged or welding ends in right- or left-hand assemblies.

Sequence of Operation. Generally speaking, the valve nearest boiler is considered the blowing valve while the second one is the sealing valve. Therefore, the logical operating order is to open the second valve first—the one farthest from boiler. Then blow-down by opening the blowing valve. Terminate blowdown by closing the blowing valve first, then the sealing valve. This procedure applies to all tandem arrangements of single valves; that is, two seatless valves, two hard-seat valves, one hard-seat and one seatless, as well as unit-tandem valves.

There is but one exception to this procedure and that is for low-pressure units where flat-seat sliding-disk-type valves are employed. However, this article is concerned only with high-pressure valves and so the procedure for low-pressure units will not be discussed.

Quick Starting. Recent studies by utility engineers show that quick starts of large high-pressure boilers from the cold condition can be made with less strain on the boiler structure than when conventional 5- or 6-hour starts are made. Success of quick starting depends on using correct procedures. These, of course, must be based on the individual installation, and few generalizations can be made for all plants.

(*Continued on page* 216)

I: Maximum Boiler Pressures for ASA Steel Flanges, Fittings, Valves

ASA pressure rating, psi	150	300	400	600	900	1500	2500
Joint type	Max. allowable saturated-steam press. at corresponding saturated-steam temp.						
Standard facing, 800 F	180	510	665	960	1360	2100	3100
Ring joint, 850 F	190	630	810	1160	1640	2500	3900
	Max. allowable boiler press. for feed and blowoff use						
Standard facing, 800 F	150	416	540	785	1120	1745	2625
Ring joint, 850 F	160	515	665	950	1350	2080	3120

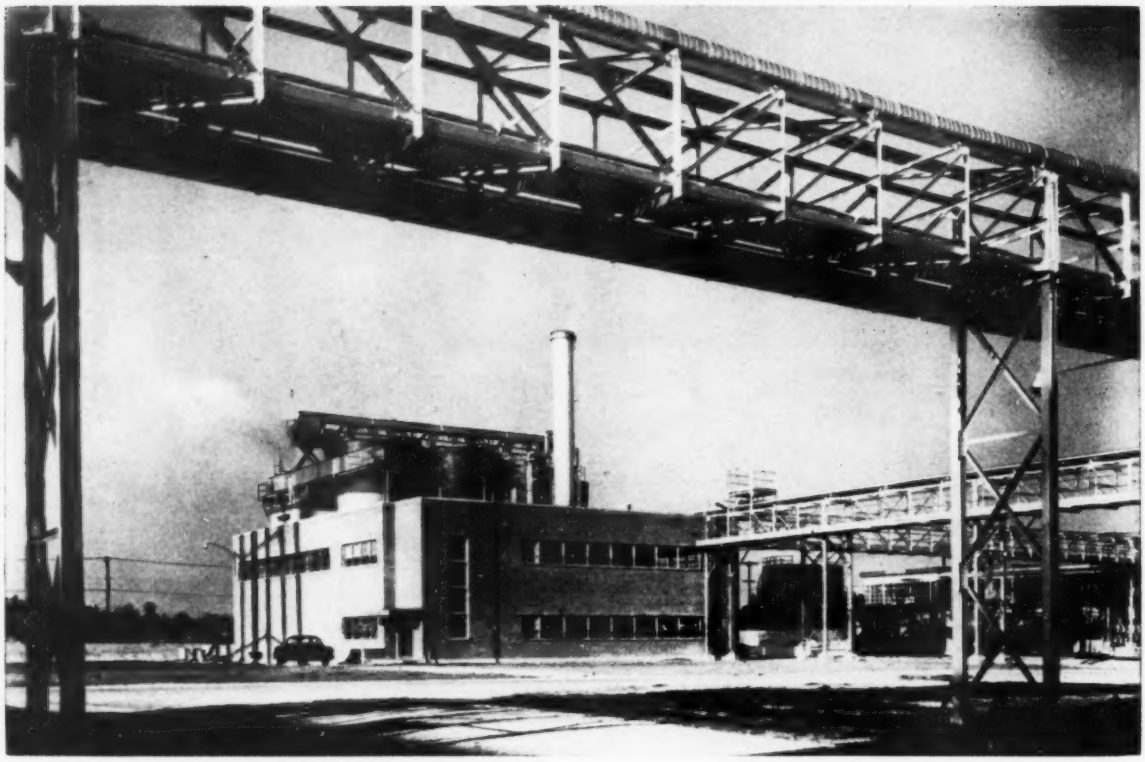
II: Valve-Selector Table (Carbon-Steel Bodies)

			Tandem units				
			Bolted			Unit	
Valve connections	*Basic press. rating, psi*	*Max. allowable boiler press. for blowoff service, psi**	*Two seatless*	*Hard-seat & seatless*	*Two hard-seat*	*Hard-seat & seatless*	*Two hard-seat*
Flanged (standard facings)	600	785	x	x		x	
Welding ends, ring joints	600	950	x	x		x	
Flanged (standard facings)	1500	1745		x	x	x	x
Welding ends, ring joints	1500	1850		x		x	
Welding ends, ring joints	1500	2080			x		x
Flanged (standard facings)	2500	2625			x		x
Welding ends, ring joints	2500	3120			x		x

* Modification of ASME Boiler Code, par P-299e, 1949 edition.

III: Resistance of Alloys in Acid Washing of Boilers

	Resistance to 5% inhibited hydrochloric acid cleaning solution at 150 F		*Acceleration of attack on SAE-1020 steel in contact with the alloy*
Alloy	*Individually*	*In contact with steel*	
Hastelloy B (rolled)	Excellent	Excellent	1.0
Hastelloy D (cast)	Excellent	Excellent	3.0
316 stainless steel	Good	Excellent	1.4
Stellite #6	Good	Excellent	Severely pitted
317 stainless steel	Good	Excellent	1.8
310 stainless steel	Good	Excellent	1.4
Hastelloy B (cast)	Good	Excellent	2.4
Ni-Resist #4	Good	Good	2.4
Ni-Resist #1	Fair	.....	.....
303 stainless steel	Fair	Fair	1.5
420 stainless steel	Fair	.....	.....
S Monel	Fair	.....	.....
K Monel	Poor	Excellent	2.8
316 stainless steel (nitrided)	Poor	.....	.....
SAE-1020 steel	Poor	.....	.....
Beryllium copper	Poor	Excellent	4.1
SAE-8630 steel	Poor	.....	.....
416 stainless steel	Poor	.....	.....



STEEL SUPPORTING STRUCTURE for main manufacturing plant's steam headers frames the coal- or oil-fired boilerhouse

Chemical Plant Builds for Continuity

Modern chemical plants require such heavy capital investments that designers build into them a full range of adequate, well-controlled services. Here's a plant that carries the idea a step farther and guarantees its basic energy needs with large-scale storage and handling facilities for both coal and oil

By **PHILIP KRONOWITT**, *Assistant General Manager, Ciba States, Ltd.*

► THE CHEMICAL-PROCESS INDUSTRIES, like all other industrials, find that power services play a continually greater part in final production cost. When our company decided on the new Toms River, N. J. plant, we made every effort to put this condition to greatest advantage. Further, our equipment selection and arrangement point up a desire for flexibility at vital points of the power cycle.

Power-service needs at Toms River run the gamut. They include (1) steam for heating a group of nine buildings in the center of a 1200-acre tract, for chemical-process kettle heating, drying and distillations (2) electric energy for lights, motors, relays, and so on (3) refrigeration for chemical-process cooling (4) air conditioning for offices, laboratories, first aid and cafeteria (5) compressed air for transfer of liquids from one vessel to another and for pressure filtrations (6) inert gas for the transfer of flammable solvents (7) Dowtherm heating for processes that need high temperatures (8) sewage treatment for purification of all industrial and sanitary sewage before disposal.

Steam Service. Our boilerhouse, photo, above, is a first-rate example of how we planned for ample service facilities with the added advantage of flexibility. We picked two 50,000-lb-per-hr, 500-psi-design-pressure, watertube boilers with waterwalls for pulverized coal or oil firing. These units are semioutdoor with firing aisle, pump room, forced-draft fans within the building and boiler casing, induced-draft fans outside.

We know the 50,000-lb-per-hr capacity stands right on the lower limit of pulverized-coal firing. But we've had a background of successful pulverized installations in other plants, and we anticipate no trouble on this score. Should plant growth require additional boilers we'll go to units double the size of the present ones and more within the normal pulverized-coal range.

Moreover, pulverized firing offers the solid-fuel system most readily adaptable to change-over for oil burning. And this flexibility, we feel, is vital to plant

economy as fuel prices swing with relation to one another. Even more, we want to insure boiler availability no matter how tight the liquid-fuel situation gets in response to world unrest.

In fact, as recently as late 1950, we decided to push the boiler-plant design beyond the earlier 1948-1949 agreement. Then we selected fuel oil for firing with provisions for future pulverized coal. With our 1950 decision, we went ahead and put in a well-integrated coal-handling plant, Fig. 1-5.

Fuel Handling. We can now handle all coal mechanically from the time it arrives in hopper-bottom coal cars until we burn it, Fig. 3. This includes delivery to initial crushing equipment, elevation, and dumping into storage silos, conveying from silos to the powerhouse.

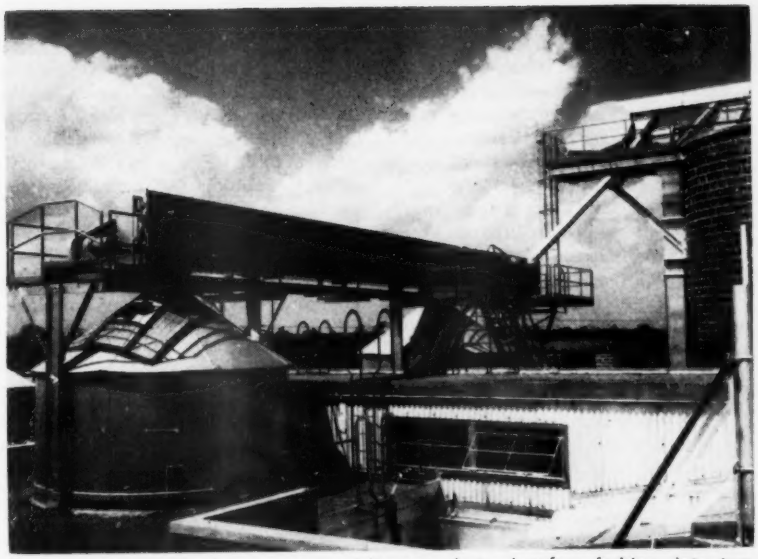
The coal-handling equipment was installed so the three 330-ton storage silos will be right in the middle of plant expansion. When more power capacity is needed, the power plant to house it will go up directly opposite the unit now running. So all present facilities can serve this as well as any future power plants.

Incoming coal drops through a track grating, Fig. 3, into underground coal-crushing equipment. From here it travels on a 38-foot-long, 2-ft-wide, trough-type conveyor belt to the elevator-conveyor or round-about conveyor, as it is sometimes called. This round-about design, 276 ft in over-all length and 2 ft wide, doubles in brass. In horizontal travel, Fig. 3 and 4, it acts as a flight conveyor. When traveling vertically, it becomes a bucket conveyor. Fig. 2 shows the conveyor on top of the silos.

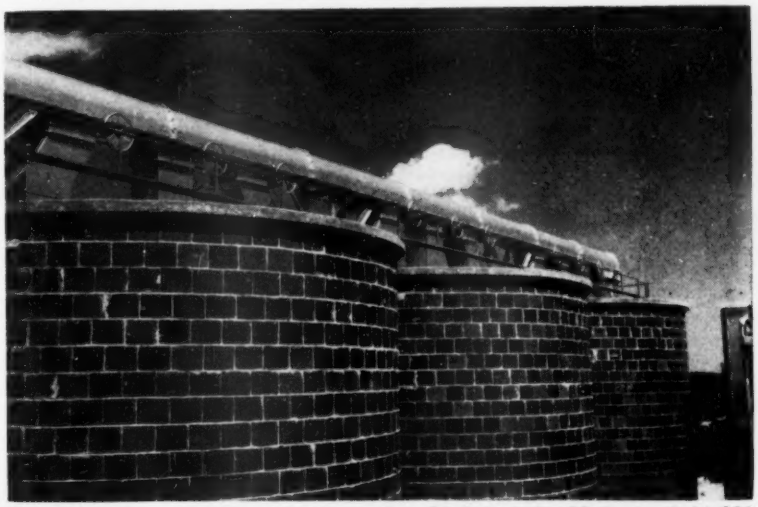
If all silos are closed, as in Fig. 3, coal from the round-about conveyor drops onto a chute which, in turn, carries the coal to a flight conveyor for delivery to powerhouse coal bins. This round-about unit can carry the incoming coal directly to silo storage, route it to powerhouse bins, or deliver it from silo storage to the powerhouse.

When coal is dumped out of the silo for delivery to the powerhouse we use a special underground feeder-car, Fig. 4. It has a conveyor-belt bottom to feed coal evenly to the round-about conveyor as it passes beneath the car. This car, track mounted, can be pushed easily under any silo. To make the car movement still easier we have spotted wall outlets at numerous points so the car's conveyor motor can be plugged in conveniently.

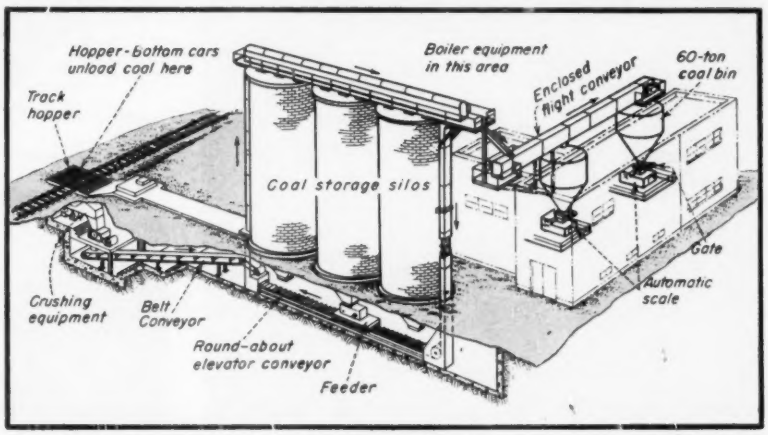
Figs. 1, 3 show the special, enclosed flight conveyor and conveyor section over the powerhouse coal bins. This 59-ft section can supply either of the 60-ton bins and can do it without develop-



1 Special, enclosed flight conveyor delivers coal, in dust-free fashion, into two, partly outdoor, steel coal bins, 50-ton capacity each, one for each boiler unit



2 Reinforced, vitrified-tile coal-storage silos, 54 ft high by 20 ft dia, hold 330 tons each; are located so as to be in middle of any future plant expansion



3 Completely mechanized coal-handling system takes over from railroad siding through storage silos and carries coal right up to individual boiler hoppers

ing any dust within the powerhouse.

Fig. 5 pictures the bottom of one of the powerhouse coal bins. Its hopper feeds right onto an automatic coal scale and then into the pulverizing mills, through motor-driven feeders.

Ash handling is carried out by a pneumatic steam-jet system with a 15-ton-per-hr capacity. Ash at the furnace-hopper bottom drops through water-cooled ash-discharge doors into this pneumatic ash-conveying system. It is carried to a receiver and separator unit, mounted on top of a vitrified-tile ash-storage bin of 60-ton capacity. This bin is equipped with a dustless rotary unloader.

The ash-conveyor system also ties into the bottom of the two tubular air heaters on the boiler units, the bottom of two mechanical dust collectors, and the stack base.

Incidentally, these tubular dust collectors—one to a boiler—supply 95% efficiency with dust particles over 40 microns, and 70% for dust particles 10 microns and over. Flue gas leaving these dust collectors enters a single, self-supporting steel stack, 75 ft high with a 5-ft diameter at the top.

Oil Storage. Oil, our alternate fuel—and up to this time because of price advantages our major one—is stored in two 150,000-gal above-ground tanks isolated by concrete walls for fire stops. Each tank has a steam-supplied suction heater of 1500-gal-per-hr capacity with a temperature range from 20 to 120 F.

In addition, two 100-gpm heavy-fuel oil pumps, connected in parallel to permit double pumping, move oil from storage to the oil preheater and pump sets in the boiler room, or pull oil out of incoming tank cars to storage.

The pump-and-heater set consists of a 1500-gph, horizontal, duplex pump, steam-driven, and a motor-driven screw-type pump, both designed to handle oils from 80 to 220 F, and two V-tube fuel-oil heaters equipped with strainers, temperature and pressure regulators.

Above arrangement embodies the elements of good fuel-oil handling, namely, adequate storage tanks, two fuel-oil pumps with adequate drivers, strainers for each pump, suction lines from each pump to each storage tank, automatically controlled fuel-oil temperature, assurances that hot oil reaches each burner or set of burners, a controlled viscosity by proper control of oil temperature and adequate pressure regulation of oil reaching the oil-control valves.

Combustion Control. A separate-instrument air compressor supplies the necessary compressed air for the automatic combustion-control equipment. This equipment mounts on a single-instrument panel and includes the fuel-oil controls, damper, coal-feed, and water-level controllers, the pressure and temperature, steam and water flow and the CO_2 recorders, plus the draft indicator.

Boilers operate at a guarantee of 86.2% over-all efficiency at a 50,000-lb-per-hr steaming rate, using a No. 6 fuel oil of 18,500 Btu per lb. With coal, the guarantee is set at an 85.3% efficiency at 50,000 lb per hr burning a 12,850-Btu-per-lb coal. Further, the boiler design permits burning a wide variety of coals up to a moisture content of 10%, an ash-fusion temperature as low as 2200 F, and a grindability index of 50.

As mentioned, all operating equipment except the induced-draft fans are housed inside the boiler room. Front walls of the boiler form part of the rear wall of the boilerhouse. But the aisle space between the boilers is enclosed up to the rear of the boilers.

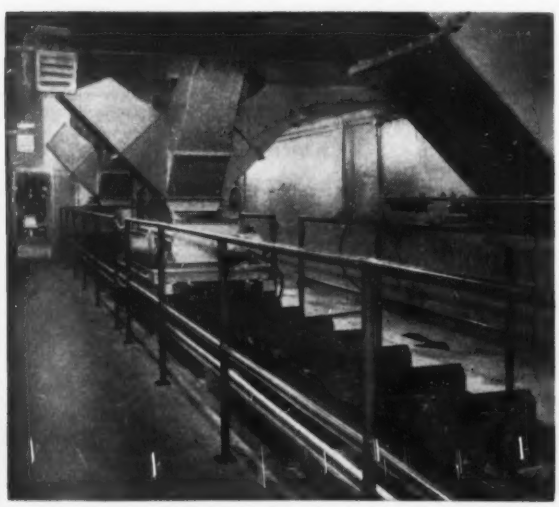
Combustion control, coal feeders, forced-draft fans and burners are on the main operating level. The basement contains feedwater pumps, pulverizers, fuel-oil pump-and-heater set, chemical feed equipment, blowdown tank, coal-conveyor tunnel, and instrument air compressors. The feedwater heater and coal scales, Fig. 5, stand on the second-floor level. They connect by a walkway to the supervisor's office, which has a continuous glass window overlooking the entire boiler room.

Water Supply. We use five metered deepwell pumps, ranging from 260 to 600 gpm each, around the plant's perimeter, about 1000 ft apart, to deliver up to 2200 gpm of water through a 12-in. transite main into a 300,000-gal elevated storage tank. This tank, 160 ft above ground level, has two standpipes. The standpipe that fills the tank reaches up halfway into it, and connects with the plant service main. The other standpipe goes to the bottom of the tank and connects to the fire-service mains, which feed the sprinklers and fire hydrants.

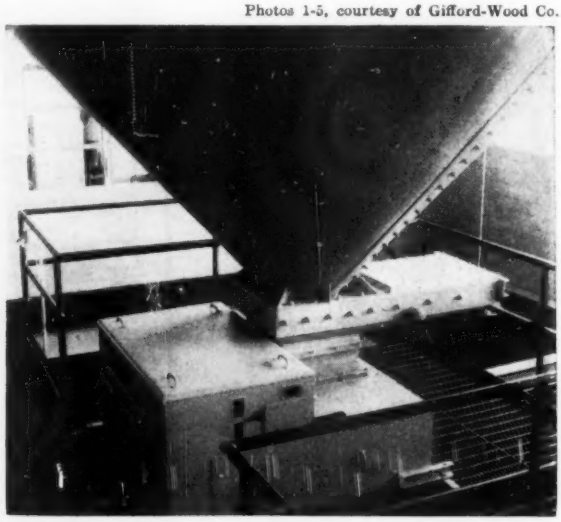
The deepwells pull water from an underground supply at about 100 ft depth, and at the 2200-gpm pumping rate do not lower the water table. Present estimates indicate the plant supply could

(*Continued on page* 212)

Photos 1-5, courtesy of Gifford-Wood Co.



4 Underground feeder car, *background*, draws coal from silos, drops it on a flight conveyor for trip to boiler hoppers



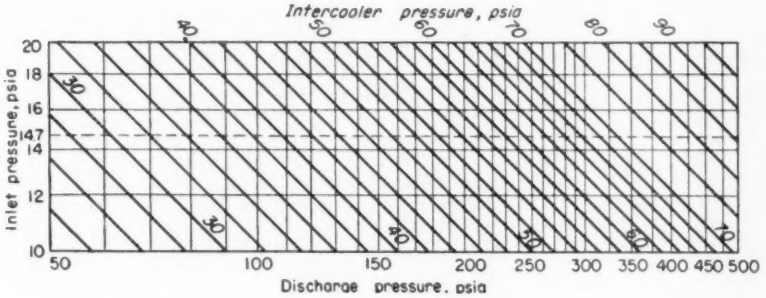
5 Automatic coal scales finish the job of mechanical coal travel from point of rail delivery to final boiler bunker

Power's DATA SHEET

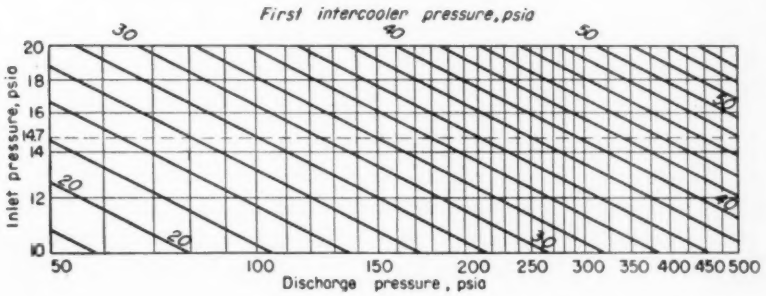
No. 255

Air-Compressor Intercooler Pressures

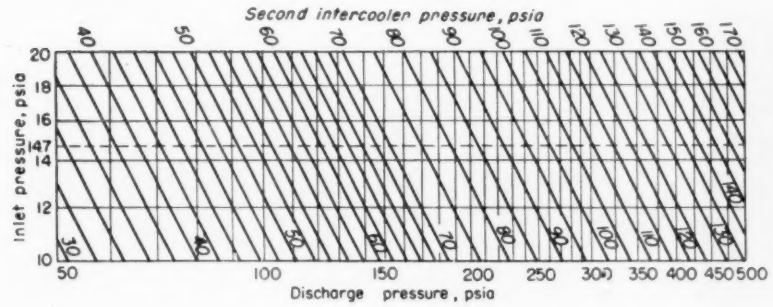
Two-Stage Compressor



Three-Stage Compressor: First Intercooler



Three-Stage Compressor: Second Intercooler



► AN IMPORTANT INDEX to the operating condition of 2- and 3-stage air compressors is the intercooler pressure. For properly designed compressors the intercooler pressure runs close to the theoretical level needed for minimum power input. If the actual pressure changes very much from the theoretical, look for trouble in your unit.

In the 2-stage compressor the correct intercooler pressure can be figured as:

$$p_i = \sqrt{p_1 p_2}$$

where p_1 is the air pressure at low-pressure cylinder inlet valves and p_2 is the discharge air pressure from the high-pressure cylinder. All pressures are total or absolute pressures.

The 3-stage compressor has two intercoolers, for the first intercooler between low- and intermediate-pressure cylinders the correct pressure is:

$$p_{i1} = \sqrt[3]{p_1^2 p_2}$$

For the second intercooler between i-p and h-p cylinders the correct pressure is figured as:

$$p_{i2} = \sqrt[3]{p_1 p_2^2}$$

The pressures p_1 and p_2 are again the inlet and discharge pressures for the compressor.

To use these charts simply find the intersection of the compressor inlet and discharge pressures, and then read this point on the slant-line curves.

Example: A 2-stage air compressor takes its suction from atmosphere at sea level and discharges at 150 psig. What is correct intercooler pressure? Atmospheric pressure = 14.7 psia. Discharge pressure = 150 + 14.7 = 164.7 psia. In upper graph find intersection of these two pressures and read 49+ psia for intercooler pressure, which is 34+ psig.

B G A SKROTZKI, *Associate Editor*

© POWER

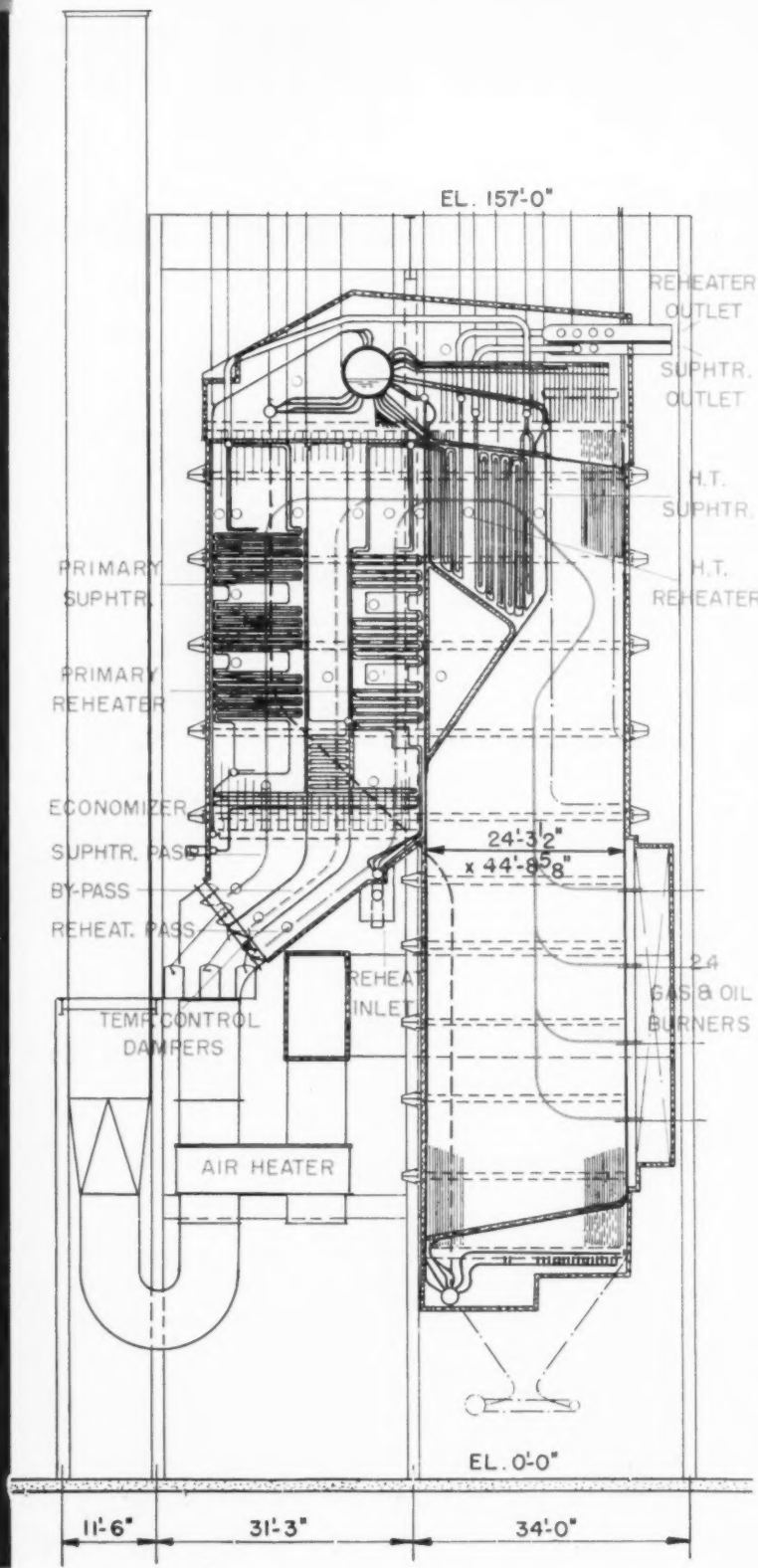
TYPICAL RILEY 1,250,000 lbs./hr. REHEAT UNIT

Capacity—1,250,000 lbs./hr.
Design Pressure—2125 psig.
Superheater Outlet Pressure—1925 psig.
Steam Temperature—1005°F.
Reheater Capacity—1,148,000 lbs./hr.
Reheater Outlet Pressure—470 psig.
Reheater Temperature—1005°F.
Efficiency Gas Firing—83.7%
Pressurized Furnace
Fired by Gas. Oil Standby
Designed for future conversion to Lignite firing.

AUTOMATIC STEAM & REHEAT TEMPERATURE CONTROL

This typical Riley Reheat installation utilizes gas by-pass dampers located in a low-temperature area beneath the Economizer to automatically proportion the gas flows over the Superheater and Reheater primary surfaces. Steam temperatures and reheater temperatures are maintained constant at 1005° Fahrenheit over a wide load range. At high loads, if required to maintain desired temperatures, part of the gases can be by-passed through the open lane between Reheater and Superheater primary surfaces. Note extra Economizer surfaces in the By-Pass line. This arrangement provides for approximate uniform exit gases.

You, too, can rely on Riley experience and know-how when considering steam generation and fuel burning equipment.



These large Public Utility Companies have ordered RILEY Reheat Units

with steam capacities as high as **1,250,000** *pounds per hour!*

- **HOUSTON LIGHTING & POWER CO.**
  1,250,000 lbs./hr.
  2075 psig. 1005°F.
  1005° Reheat
- **DALLAS POWER & LIGHT CO.**
  1,250,000 lbs./hr.
  2075 psig. 1005°F.
  1005° Reheat
- **TEXAS ELECTRIC SERVICE CO.**
  1,250,000 lbs./hr.
  2075 psig. 1005°F.
  1005° Reheat
- **PUBLIC SERVICES OF INDIANA**
  884,000 lbs./hr.
  2050 psig. 1005°F.
  1005° Reheat
- **DEPT. OF WATER & POWER**
  City of Los Angeles, Cal.
  1,200,000 lbs./hr.
  2075 psig. 1000°F.
  1000° Reheat
- **LOUISIANA POWER & LIGHT CO.**
  1,000,000 lbs./hr.
  1725 psig. 1005°F.
  1005° Reheat
- **UTAH POWER & LIGHT CO.**
  575,000 lbs./hr.
  1700 psig. 1000°F.
  1000° Reheat

These are but a few of the big Riley installations that are being ordered by power companies in State after State across the country. The Houston Lighting & Power Company, one of the large Southwest public utilities, has recently ordered two of the big 1,250,000 pounds per hour Riley Reheat Units. These will be their tenth and eleventh Riley units, nine others having been installed during the past fifteen years. These Riley units will increase the Houston Company's steam capacity to over 7,000,000 pounds per hour Both the Texas Electric Service Company and the Dallas Power & Light Company will also increase their power generating facilities with similar units of 1,250,000 pounds per hour capacity . . . . conclusive evidence that Riley enjoys the confidence of increasing numbers of big, expansion-minded power companies.

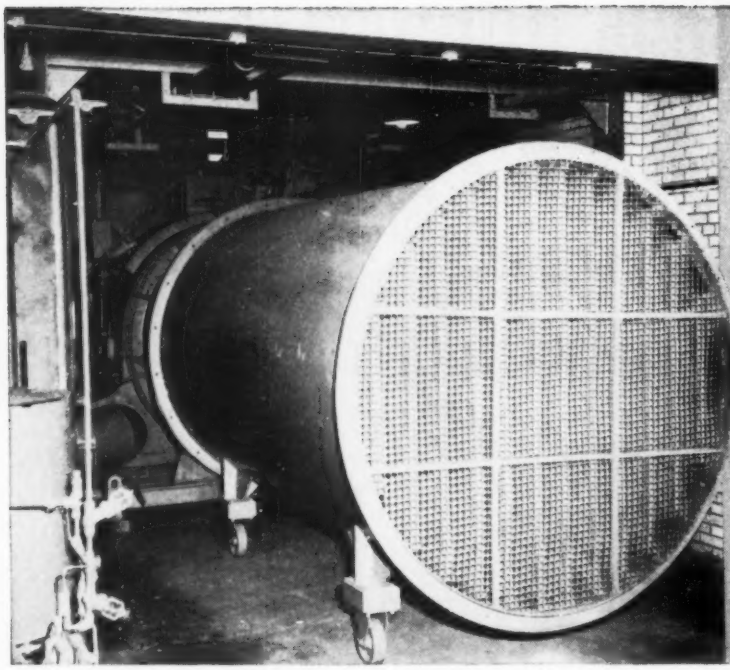
TRADE MARK Rx REGISTERED

RILEY
STOKER CORPORATION

WORCESTER, MASS.
Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, Portland, Seattle

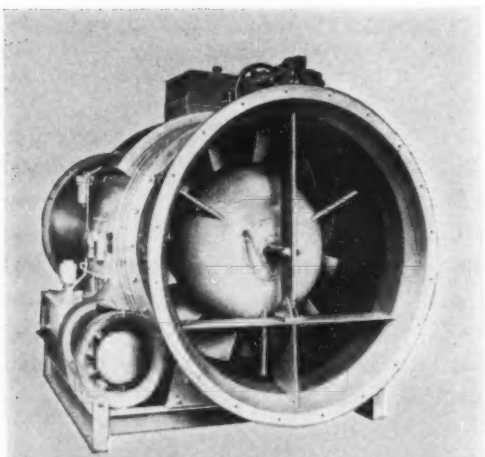
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS



in JOY AXIVANE® FORCED DRAFT FANS...

...You get *EXCLUSIVE* advantages



JOY Fan with sound-absorbing set removed

The illustration above shows a JOY Axivane Forced Draft Fan (rear) and its sound-absorbing set (front) installed under a pressurized-type boiler in minimum headroom—one of the advantages of its compact, highly efficient vaneaxial design. Other advantages are: favorable air volume-to-power ratio, low noise levels, easily installed, readily accessible, and trouble-free operation with least maintenance.

Principal advantage, however, is the great saving on power at reduced volumes. JOY Forced Draft Fans employ *variable-pitch blades,* manually or automatically controlled, as desired. For example, compared to other volume control methods, at 50% of rated volume JOY Variable Pitch requires only 25% of rated power, against 45% for Vane Control and 70% for Damper Control. ● Let us engineer *your* forced draft requirements and demonstrate the savings possible.

WBD 1 6169

Consult a Joy Engineer

OVER 100 YEARS OF ENGINEERING LEADERSHIP . . . WORLD'S LARGEST MANUFACTURER OF VANEAXIAL-TYPE FANS

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

QUICK PIPING HOOKUP is made to fuel-oil heater by burning holes and welding. No drilling, tapping or other costly work

MAINTENANCE WELDING PAYS

By **RUSS KEMBEL**, *Bethlehem, Pa.*

- ***High repair costs make welding an important maintenance tool***
- ***Everything from cast iron to aluminum is easily welded by topnotch welder***
- ***Porous welds in cast iron can be sealed so they are water-tight***
- ***Electric-arc and oxygen cutting slash big repair costs in many ways for maintenance***

► MAINTENANCE is most important in American industry today because of high expenses. Every engineer knows that down-time means sky-high costs for products. So to keep industrial wheels moving, manufacturers turn to the quickest way to maintain equipment. Answer is welding.

There are many ways to fuse metals. Fusing can be done with a forge, a torch, or electrical and thermite processes. In the relatively short know-how of welding, over 47 techniques have been developed, such as squirt, stick, submerged, heli-arc, etc.

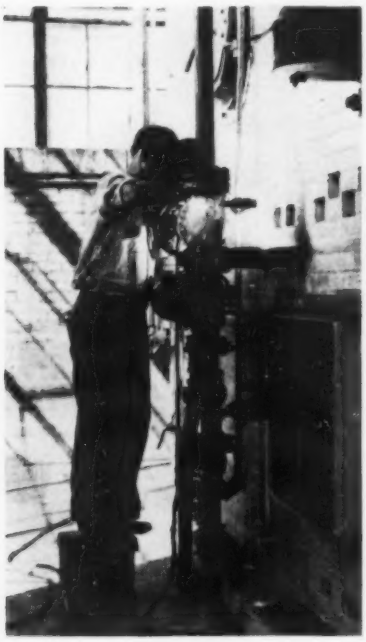
Electric arc welding is most important for maintenance. Arc can be used for joining all weldable metals. Electrode firms have perfected electrodes for all jobs, under all conditions. Suppose we talk about ways of doing the welding job.

Power, petroleum, metal, mining, railroad, automotive, steel and cement plants—all have their own repair problems. But maintenance welding is about the same for all metals used.

Maintenance welding can be classified in sections, such as cast-iron, hard-facing, high-strength-tool, fabrication and construction, light-metal-casting, and mild-steel maintenance.

Maintenance welder does all types of jobs. He repairs a coal pick that breaks in half. Also, he repairs a big crack in a large cast-iron block, or resurfaces teeth on a crane bucket.

Cast iron has low ductility (won't stretch much before breaking or cracking). Remember this when welding cast iron with an electric arc. Although cast iron must be preheated when welding with oxyacetylene torch, it can be welded with metal arc without preheating. But control welding heat, and make joint carefully to avoid trouble.



PIPE HANGER is welded to wall bracket at right spot. No measuring, machining

WELDING ROOM has 300-dc machine and stock of electrodes to handle most jobs that come up. Auxiliary tools needed depend on type of maintenance in your plant

Weld only short lengths of joint at a time. Then allow to cool so entire casting won't expand and crack. Welding heat is then confined to a small area, with little danger of cracking. Large castings with complicated sections, such as motor blocks, can be welded without dismantling or preheating.

Chip out edges of joint or clean by grinding to form a 60-degree included-angle of bevel, before welding. Extend the "V" to within $\frac{1}{8}$ in. of crack's bottom. When repairing a crack in casting, drill a small hole into casting at each end of crack to prevent spreading. Remove grease, dirt, and other foreign materials by washing with carbon tetrachloride or Stoddard's solution.

Cast iron can be welded with a steel-base-coated electrode. In using this type electrode, consider contraction of steel weld metal, carbon picked up by weld from cast iron, and hardness resulting in weld metal from rapid cooling.

Steel shrinks or contracts more than cast iron when cooling from a molten to a cool state. After welding, this uneven shrinkage causes strains in joint. When a lot of filler metal is applied to joint, cast iron may crack just back of fusion line.

To overcome cracking, weld the prepared joint by depositing weld metal of string beads in short $\frac{3}{4}$-in. to 1-in. lengths at a time. Make short welds intermittently. In some cases use back-step and skip procedure. Back-step welding offsets contraction. This is done by welding a few inches. Then move a few inches ahead of weld and work back to bead just finished. Always weld in one direction.

To avoid hard spots, strike arc in "V," not on base metal's surface. Peen each short length of weld metal applied to joint. Use a light ball-peen hammer while weld is still hot. Then allow to cool before depositing more metal.

Peening (mechanical working or stretching of cold-metal surface with hammer blows) forges metal and relieves cooling strains. This reduces danger of cracking in weld or base metal. And cooling between beads reduces amount of heat applied to parts being welded. Use $\frac{1}{8}$-in.-diameter electrodes to keep heat down.

Weld only with reverse polarity (for reverse polarity, arrange direct-current arc-welding leads so work is negative pole, electrode is positive pole in arc circuit). Keep welding current at about 80 amperes on $\frac{1}{8}$-in. electrode. Then weave electrode as little as possible. Clean each weld-metal deposit with chipping hammer or wire brush before adding more metal.

Welds made with steel electrodes are generally three to four times as strong as base-metal casting. To insure that welded joint is liquid- or gas-tight, apply composite sulfur and graphite-powder bar to finished weld. Do this after cleaning and while still hot.

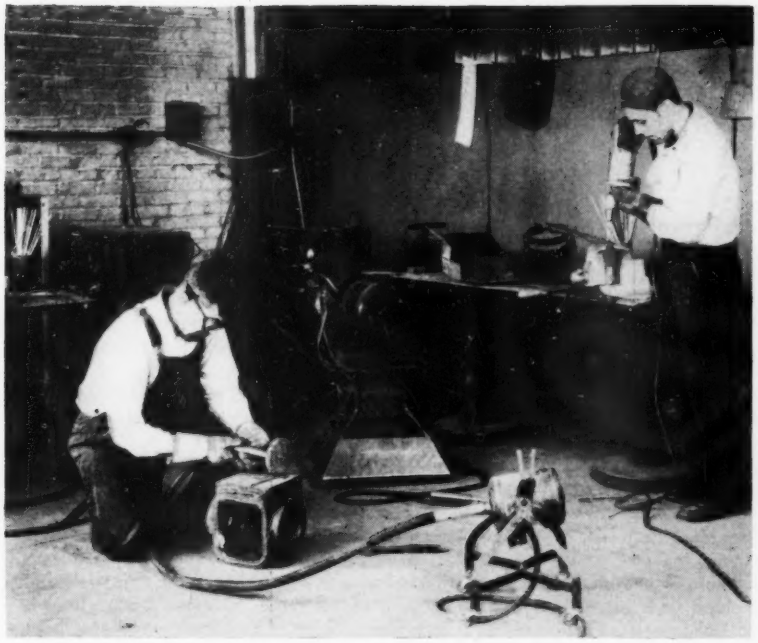
Sealing Porous Welds. Welds in cast-iron, such as cylinder blocks, require watertight joints. That means free from pores, minute cracks or other defects that leak. Apply a sealing coat made of powdered sulfur and fine graphite powder to completed weld.

Prepare by melting four to five parts of sulfur and adding one part of graphite. Continue heating, and mix graphite thoroughly with sulfur. If mixture ignites, extinguish flame by smothering with asbestos paper. Cast into long bars by pouring mixture into "V" of an angle-iron section, lined with paper. Remove cast bar when cold. Scrape off paper before applying to weld.

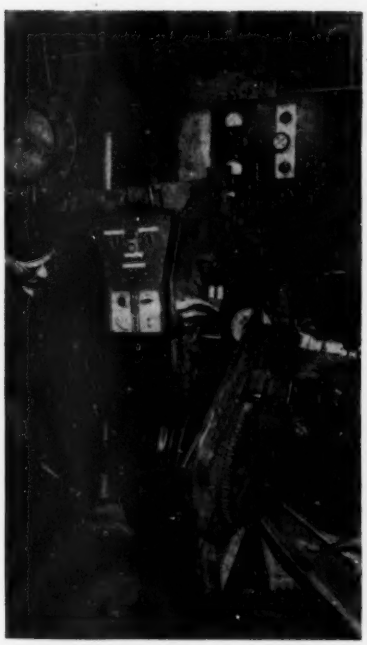
Coat cast-iron welds with this sealing stick while weld is still hot. Rub end of cast bar into hot weld so bar melts off thin film onto weld. Film seals openings as weld and seal-film cool. Chip off surface scale, slag, and other foreign material, or wire-brush from weld before applying sealing-bar material. You can seal welds like this on either arc or torch welds.

When using little or no preheating, as in arc-welding cast iron, treat each small section of welded joint while metal is hot, after chipping. Bar can also be applied to cold welds. First heat weld carefully with oxyacetylene torch.

Cast iron can also be welded with heavy-coated monel, cast-iron, or stainless-steel electrodes. Procedure is the



PORTABLE power tools in welding shop are good investment. Ones shown here are flexible-shaft grinder and electric drill, two tools your welding shop must have



AUTOMATIC HEAD feeds the electrode and turns the worn casting all by itself

same as for welding with mild-steel electrodes. Peen weld-metal to prevent cracking.

Stainless-steel electrodes give a better bond between filler metal and base metal at joint. But use extreme care to avoid cracking in weld and in fusion zone. Reason is stainless steel expands and contracts about 50% more than mild steel for same temperature change. Welds made with monel or nickel containing electrodes can be machined to a finished dimension.

Heavy sections of cast iron can be welded with heavy-coated mild-steel electrodes. Just follow outline above. Studs or grooves are sometimes used to strengthen welded joints mechanically. These steel studs should be ¼ to ⅜ in. in diameter. Give cast iron a V-angle bevel at joint.

Screw studs into holes drilled and tapped along "V." Project studs about 3/16 in. to ¼ in. above cast iron surface. Make long enough to be screwed into tapped holes to depth of stud diameter. Space studs from 1 to 2 in. apart. Arrange studs in line along bevel face. Seal-weld projecting ends in place by one or two beads around each stud.

Tie these studs together with weld metal. Make welds in short lengths. Peen each length while still hot to prevent high stresses or cracking upon cooling. Allow each deposited bead to cool.

Clean thoroughly before adding more metal to joint. Where it's difficult to apply studs to joint, chip casting edges or machine with a round-nosed tool, or round-nose portable grinder, to form long U-shaped grooves on surfaces and face of each bevel at joint. These grooves anchor weld-metal deposited in joint. They also help increase mechanical strength.

Electric arc cutting is different from oxygen cutting as it cuts by melting rather than by rapid oxidation. Arc cutting with shielded metal-arc electrodes usually takes straight polarity (electrode negative) and a long arc. Here are currents for metal-arc-cutting:

Electrode Diameter	*Current*
5/32 in.	300 amp
3/16 in.	400 amp

Metal-arc cutting works best with mild-steel electrodes of down-hand deep-groove type. They should have heavy coating, to permit using high currents. Coating burns off slowly, so arc can blow and push molten metal out of cut.

Current needs for metal-arc cutting are much higher than for metal-arc welding. Make polarity adjustments for minimum electrode burn-off rates. As this is fast burning, you may have to grind off edges of area to be welded.

Training. Various electrode and welding equipment manufacturers conduct short courses in welding. It's good practice to have not only beginners, but also key men in maintenance welding attend these courses. They become better welders, and have a chance to keep up with latest developments. Welding is moving ahead so fast that this is the most practical way to keep up with it.

EQUIPMENT NEEDED

FOR THE SHOP:

1. Dc welding generator
2. Welding cables
3. Supply of electrode holders
4. Supply of electrodes (all grades)
5. Grinders (shop and portable)
6. Acetylene equipment (shop, portable)
7. Clamps (for weld leak)
8. Welding tables (to hold job)
9. Back-up bars (to hold job secure)
10. Materials for occasional repairs on all equipment
11. Heat sticks (to measure heat in job)

FOR THE WELDER:

1. Helmets
2. Hand or face shields
3. Chipping hammer
4. Wire brush
5. Gloves
6. Safety glasses

FOR FIELD WELDING:

1. Portable dc generator (gasoline driven
2. Portable acetylene outfit
3. Portable grinder

A CLEAN SHOP and clean equipment make a safe weld department.

OPERATORS' NOTEBOOK 67

Solid-Wheel Turbine

How Turbine Works

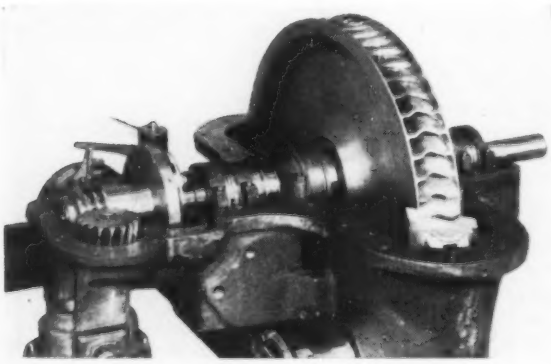
"SOLID WHEEL" TURBINE is an impulse, helical-flow type, used mostly for noncondensing service. Steam issues from expanding nozzle, at high velocity and enters side of wheel bucket. There steam direction is reversed 180 degrees. Stationary reversing chamber returns steam to moving wheel, where process is repeated until most of steam's energy is spent.

These machines are sturdy, compact, and can take a lot of abuse. Blades and wheel are one piece, and blades have large clearances, with double-rim protection. End play won't damage turbine, and blades won't foul.

Close blade clearance isn't too important because power-producing action of steam acts on curved surfaces at back of buckets. Blade wear has little effect on performance. Steam enters and leaves at right angles to shaft, so there is almost no end thrust. Rotor can be removed from shaft because it's not shrunk on.

If not loaded, turbine can be started up cold in a few seconds. (But always warm up, if possible.) With large wheel clearance and little load on thrust, danger of blades rubbing is small. But because of all these features, this turbine is often neglected and abused. For best results, give it the attention shown here.

Look Inside

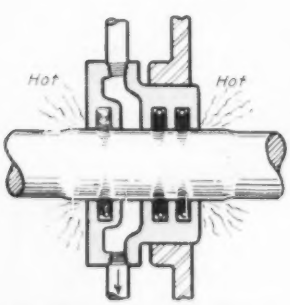


STURDY machine stands punishment, but don't be afraid to open for needed maintenance. Check shaft bearings for wear. Allow clearance recommended by maker for your machine. Main bearings also take thrust wear. If over 0.025-in. thrust clearance, renew bearings. Check shaft to see if it's bent, worn at bearings and at carbon rings. If shaft must be replaced, loosen shaft nut on side of wheel, and press wheel off shaft.

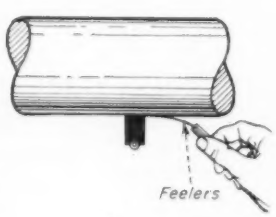
Don't wait until the wheel rides on the bottom reversing chamber. With shaft and wheel removed, inspect nozzle, then run wire through it. Also, inspect reversing chamber for wear.

When starting up turbine, first open exhaust so machine warms up gradually. Make sure drain is open so condensate is removed as fast as it forms. Drain should be left open when machine is not running. After machine is warm, crack throttle and turn over slowly until all water works out. Make sure oil rings in bearings turn before leaving machine.

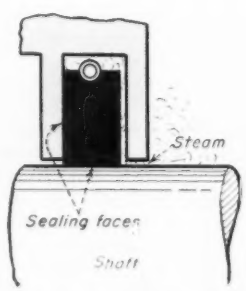
Carbon Seals



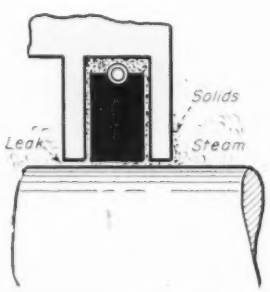
FRICTION expands shaft if sealing steam fails, grooves



CLEARANCE between shaft, carbon rings must be right



SEAL against casing—shaft, same as with a piston ring

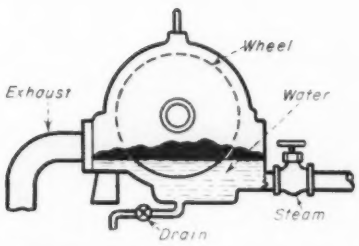


CARRYOVER from boiler deposits solids, then rings stick

Is Tough Work Horse

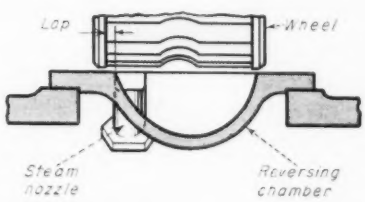
By STEVE ELONKA, *Associate Editor*

Watch These Details

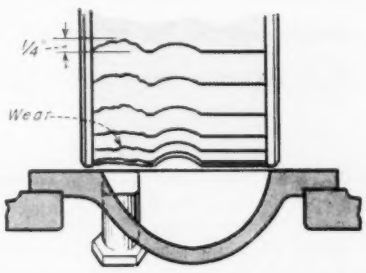


CORROSION is tough if drain is closed on idle turbine. Water floods casing

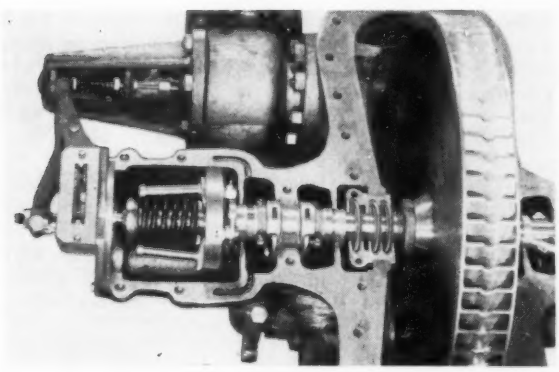
Dia wheel	Lap
18 in.	1/16 in.
24 in.	1/16 in.
36 in.	3/32 in.



LAP changes with thrust wear. Check every time turbine is open—inspected



WEAR of 1/8 in. to 1/4 in. on bucket lips opposite the nozzle will down efficiency

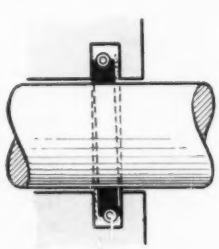


GOVERNOR is constant-speed fly-ball type, spring opposes centrifugal force of governor weights. As speed rises, weights move out, closing governor valve. When speed drops, weights move in, allow valve to open. Look for knife edge on weight lever's ends—so that governor will not stick. Slide contact and slide shoe wear. Governor yoke wears into shaft.

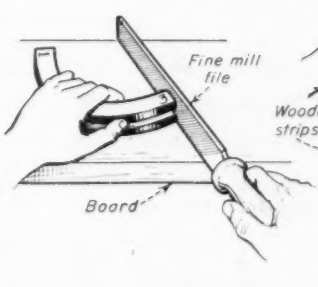
Seat of governor valve wears—avoid this by adjusting steam with nozzle so valve does not throttle. That also prevents chatter. If governor hunts, look for improper valve setting, sticking or lost motion in mechanism. Find lost motion: move governor lever by hand, observe all parts.

Common fault is tight valve-stem packing that doesn't allow valve to work freely. Loosen packing or repack. Sticking is from bent or bruised valve stem—or valve wings rusted or scaled. Molded sleeve metallic-packing used needs no lubrication. Just keep packing tight enough so it doesn't leak.

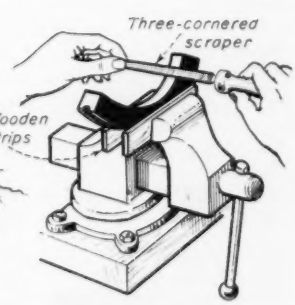
PARTICLES of wear—carry-over wedge ring ends open



RINGS COCK from sediment, then they break very easily



FILE ends until clearance is right between shaft—ring



SCRAPE uneven surfaces to fit shaft for a perfect fit

Preventing Plugged-Up Air Heaters

The job of controlling corrosion and, worse yet, solid build-ups in tubular air heaters seems like a never-ending one. But here's some background on the problem and what's being done in design, material selection, operation, maintenance to get control

By E F ROTHEMICH and G PARMAKIAN
Riley Stoker Corporation

► EVERY OPERATING MAN knows how plugged-up air heaters can cripple a boiler. Today, with a lot of plants converting from one fuel to another to get the benefit of competing fuel prices, the problem has become a lively one. There's a lot of study going on to lick it, though. For instance, research is trying to identify the right alloy steel, table below, for air-heater service, and even the proper condition of flue gas, oxidizing or reducing, for long trouble-free air-heater life.

You'd sure think this problem has been around long enough to be worked out. The theory of what happens is pretty well-known. Stated simply, sulfur dioxide formed in the normal combustion of sulfur oxidizes to sulfur trioxide, and especially so in the presence of a speed-up helper like iron oxide. The more sulfur forms, the higher the dewpoint of the gases rises. Unless flue gas passing through the air heater, Fig. 1, stays at a temperature above the dewpoint one, the water vapor condenses, forms an acid with this sulfur trioxide, and corrosion and air-heater plug-up follows. Then the plugging deposit gets into the act by helping to boost the dewpoint temperature still higher, and the corrosion goes on that much faster.

From this account it looks like temperature, and especially air-heater metal temperature, is the answer to the problem. In general, corrosion and plugging seem to confine themselves to the cold end of the heater tubes, and seldom extend beyond the region of the cold-air plenum chamber. Our company ran a survey[1] of a large number of installations to pile up data on air-heater plugging. We found that plugging and corrosion may develop only in the first row of tubes and can extend back as far as the eighth, Fig. 2, with the average penetration, three rows.

Temperature Controls. We've seen a lot of plants trying to correct this cold-end condition by different means. All methods exact a cost in one way or another. For example, when you bypass a part of the incoming air, you reduce the amount of heat picked up from the stack gases. You have, in effect, raised the air-heater metal temperature because your exit temperature runs higher. But boiler efficiency drops.

If you elect to recirculate a portion of the hot air from the outlet of the air heater back to the inlet of the forced-draft fan, you get about the same effect with less loss in efficiency. But when you have to recirculate at full boiler loads, then you're in trouble. You are adding to fan load.

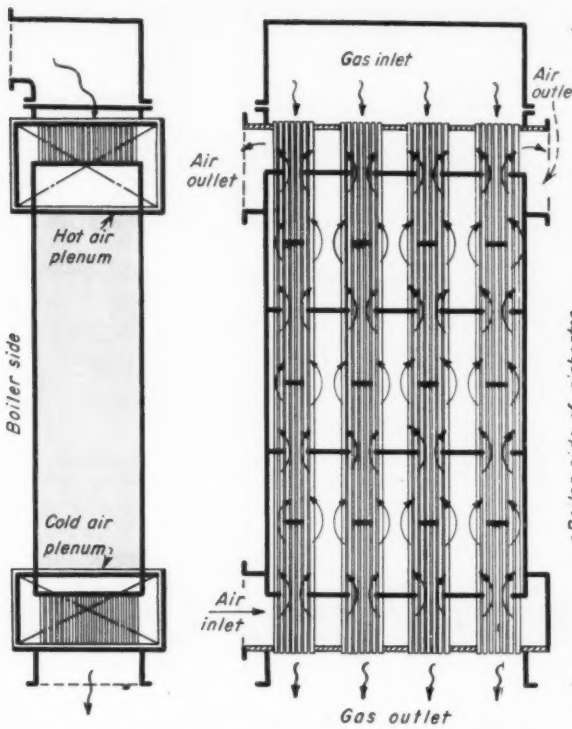
Some of the outdoor plants put steam air heaters ahead of the tubular ones for full or near-full load conditions. What's more, this extra heat supply helps considerably in cold climates. However, this steam heating will cost you some money.

[1] *Tubular Air Heater Problems*, by E F Rothemich and G Parmakian, Riley Stoker Corp. ASME Paper No. 52-A-124.

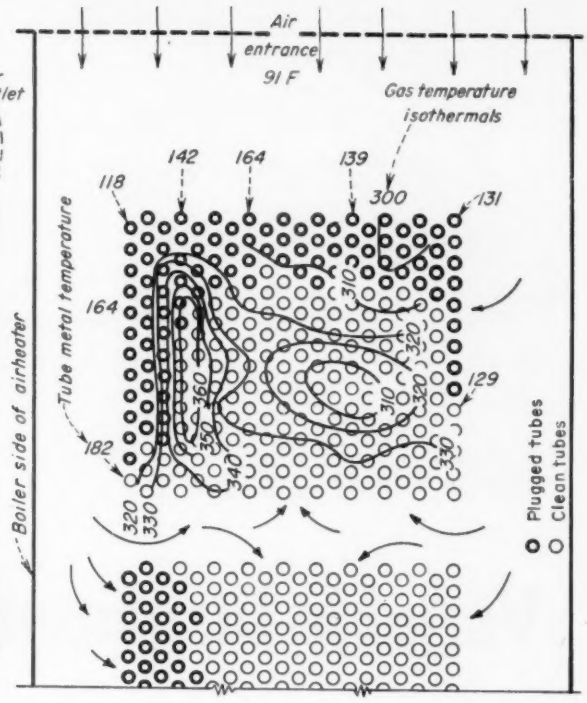
Different Air-Heater Experience With 4½ to 5½ Percent Sulfur Oil

Item No.	Material	Date installed	Date inspected	Temperature 50% load Metal	Temperature 50% load Gas	Temperature 80% load Metal	Temperature 80% load Gas	Reported condition	
A	18-8 stainless steel	8/5/48	11/3/48	120	300	130	380	Corroded at rolled end; complete failure	2½x11 BWG
B	Brass	8/5/48	2/28/49	130	320	170	380	Very little corrosion*; badly plugged; still in service	2½x11 BWG
1	B&W Croloy 1¼	12/3/48	2/28/49	120	300	130	380	No corrosion*; tubes plugged	2½x13 BWG
2	B&W Croloy 5	12/3/48	2/28/49	125	310	145	370	Slight corrosion*; partially plugged	2½x13 BWG
3	Alcoa 3S-H14	12/3/48	2/28/49	170	315	170	375	Complete failure	2½x13 BWG
4	Alcoa 61S-T6	12/3/48	2/28/49	130	320	160	380	Complete failure	2½x13 BWG
5	Alcoa Alclad inside 3S-H14	12/3/48	2/28/49	125	310	150	380	Slight corrosion; partially plugged	2½x13 BWG

* Later inspection revealed excessive corrosion, and materials were considered unsatisfactory for air-heater service.



1 Typical tubular air heater brings its cold air in and passes it through counterflow to departing hot flue gas as in above



2 Plugging and corrosion at the cold end of air heaters, left, tend to confine themselves to the first few tube rows

Try as you may, though, you can't honestly predict a safe value for tube-metal temperature, even for a given set of conditions. The reason is that sulfur trioxide is the basic source of the corrosion process, and it is impossible to determine what proportion of the sulfur in the fuel will eventually change over to the trioxide form.

Materials. The usual air-heater tube is made of low-carbon-steel tubing. Table, on facing page, gives the results of a series of tests in seven different materials tried in one long-suffering air heater. It was an oil-fired unit with a fuel oil ranging from 4½ to 5½% sulfur. None of these so-called corrosion-resistant materials gave any better experience than the original low-carbon steel.

Arrangement. Right now, though, where a plant man has a troublesome air-heater installation, he wants tips on what he can do, not what's ahead. If he's willing to pay the price for a higher metal temperature he can try one of the methods covered under temperature controls.

If he's lucky enough to have the space or the time, he should give long thought to getting correct air-heater air and gas distribution. Space, however, is usually a tight commodity. You have to go to spreader, turning and deflecting vanes in the ductwork of the air intake and the flue-gas approach to the air heater.

Wherever possible, arrange the air heater so you can wash it conveniently and drain away the wash water. If you can, set it up so that the flue gas leaves the air heater in a downward direction. Then condensate that forms can't flow the entire length of the tube, and corrosion problems are localized. Furthermore, this arrangement lets you water-soak the plugged tube ends.

If you avoid putting in dust collectors ahead of air heaters on coal-fired units, you'll reduce the likelihood of serious plugging of air heaters.

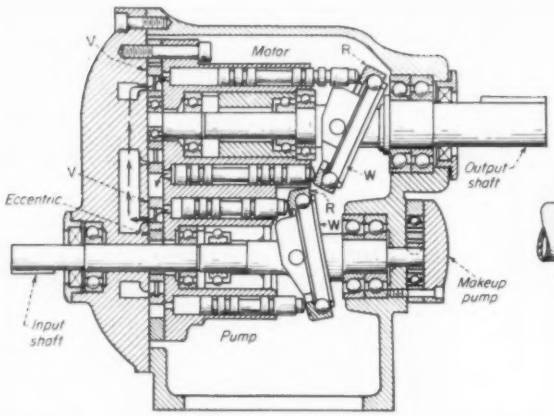
Operation. The survey[1], which we referred to earlier on air-heater plugging, set oil-fired units as averaging an air-heater cleaning once every 5½ months; pulverized-coal units, once every 7½ months; natural-gas installations, once a year whether they needed it or not. Cleaning time varied from 8 hr minimum to 160 hr maximum. Turbine cutter was the most popular tool.

Best method for cleaning crystalline or chemical deposits, though, seems to be washing with hot water. If the tube's completely plugged, let it remain full of water for a period of time. Then follow up by drying, preferably by returning the unit to service so heat is applied. The arrangement of air heater, hoppers, ducts and fans determines whether you can water-wash or not.

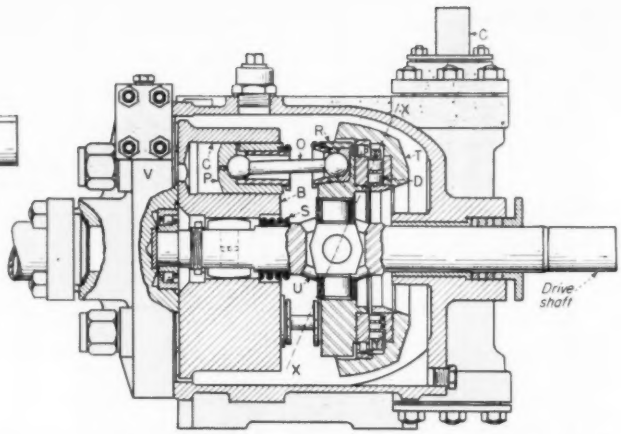
Some plants clean air heaters with solid material while they're operating. One, operating a 150,000-lb-per-hr boiler that burns waste refining fuels, uses 200 lb of No. 3 sandblast sand once each week. The men inject it by compressed air into the flue-gas stream at the inlet to the air-heater tubes. The sand drops out of the gas stream into an ash hopper at the air-heater outlet. This plant claims it has practically eliminated plugging and has also cut the cleaning time from seven man-days to two.

Another 175,000-lb-per-hr, oil-fired boiler injects 200 lb of ⅜-in. crushed rock once a week at either side of gas entrance to heater. The stone is caught in a dust collector and discarded because of its low price, $1.38 per ton.

Air lancing has been reported as quite effective. And still another suggestion is intermittent firing of pulverized coal on oil-burning installations designed for both coal and oil firing. Results, though, seem spotty. The most optimistic user operates pulverizer one hour each day. Naturally, effectiveness of this cleaning method depends on flyash coarseness.



1 Displacement of pump and hydraulic motor of this variable-speed drive is changed by adjusting the wobbler plate *W*



2 Parallel-piston variable-displacement pump in which the cylinder barrel with its pistons rotates with drive unit

Variable-Displacement Pumps Control

Here's how to apply variable-delivery pumps to those jobs where fluid flow must be held within close limits. Read on—these solid facts will be a big help to you

By F A ANNETT, *Contributing Editor*

► DISCHARGE of centrifugal pumps can be adjusted by throttling, if they run at constant speed, but output of constant-delivery pumps cannot be throttled. If their discharge has to be adjusted, pump must provide some means for doing this. About every type of constant-delivery pump has been developed in variable-displacement designs. These include rotary-piston, plunger, rotary, diaphragm and pulsating types.

Rotary-piston pumps are made in several designs for variable-displacement service. They are used as part of variable-speed power transmissions for stokers, paper machines, machine tools, and many other units, and to supply pressure fluid to hydraulic cylinders in presses, ship-steering gears, steel-furnace chargers, bulldozers and other applications. These pumps are of two general designs: parallel-piston and radial-piston.

Parallel-Piston Types. Fig. 1 is a cross-section of a hydraulic variable-speed transmission and torque converter. It has a variable-displacement multipiston pump, which delivers oil to a variable-displacement fluid motor of the same design. The piston barrels do not rotate, nor are the pistons connected to wobble plates *W*. Free ends of the pistons are spherical and ride against ring *R* that rests against a ball-thrust bearing on the wobble plate.

A small makeup pump, driven by the input shaft, supplies oil from a reservoir for charging pump's pistons to hold them on their return stroke against wobble-plate face. It also supplies oil lost by piston leakage or slippage in the closed circuit between pump and motor. Oil not required to replace the leakage is bypassed through a relief valve and used to lubricate the wobbler and bearings of pump and motor.

Eccentric on pump and motor shafts actuates circular valves *V* to control oil flow from pump to motor. These valves do not rotate but are given a gyrating motion as the shafts turn, to open and close ports leading to pump and motor cylinders.

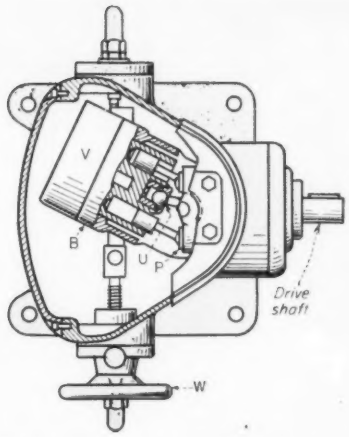
How It Works. In Fig. 1 the pump's bottom piston has completed its suction stroke, and the top one its discharge stroke. The path of this discharge is indicated by arrows to the top piston, which has completed its driving stroke. When the pump wobble plate makes one-half revolution its top piston will have completed its suction stroke and the bottom piston its discharge stroke. During this period, if pump and motor wobblers have the same angle, the motor shaft makes half a revolution. In doing this the motor's top piston moves to full discharge and its bottom piston to full driving position.

If pump's wobbler is set at an angle to give its piston one-half the stroke length of the motor, the motor shaft rotates at one-half pump speed, but output torque is double input torque. But if pump's wobbler is set for full stroke and that of motor for half stroke, motor speed will be double pump speed, and motor will develop one-half the torque of the pump. Hydraulic-control mechanism regulates angle of wobbler plates.

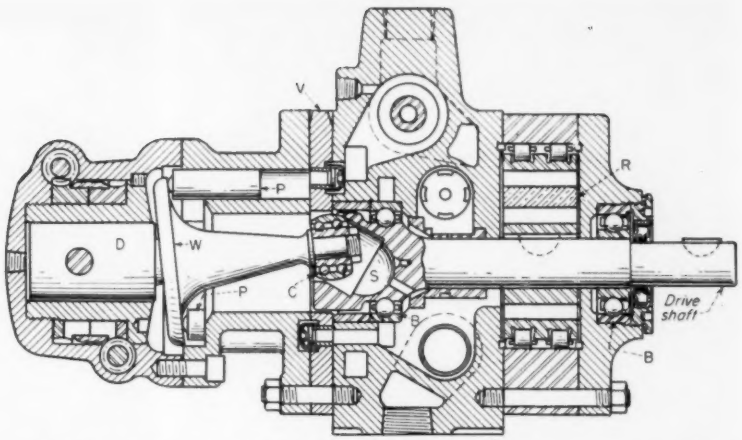
Tilting Plate. In the pump, Fig. 2, the cylinder barrel with its pistons rotates with drive shaft. It consists of a tilting box *T* in which socket ring *R* revolves. Box *T* is held stationary by a connection to control worm *C*. Socket ring *R* connects to input shaft through a universal joint *U* and rests on roller thrust bearing *D* in tilting box *T*, on which it revolves.

Socket ring has seven or nine bronze sockets for an equal number of piston-connecting rods *O* with spherical ends. Pistons *P* and cylinders *C* are ground to a good fit, which keeps leakage low without use of piston rings.

Spiral spring *S*, between cylinder barrel *B* and a collar on input shaft, holds



3 In this pump the cylinder barrel with its pistons swings at an angle to the drive shaft to adjust discharge rate



4 Variable-displacement wobbler-plate pump in which the wobbler plate marked W does not rotate with the drive shaft

Fluid Delivery to Meet Load Needs

barrel against valve plate *V* when they are not under pressure. When pump is running, the barrel is held against valve plate by pressure resulting from the difference in the valve-plate and cylinder-port areas. Two semicircular ports in valve plate connect to suction and discharge ports in the cylinder-barrel face. Each valve-plate port extends about 120 deg on the cylinder side. Barrel *B* has as many equally spaced semicircular ports as it has cylinders. As barrel revolves with input shaft, its ports pass in succession over the valve-plate ports. One of these acts as a suction and the other as a discharge port for the pump cylinders.

Piston Discharge. Tilting Box *T* and socket ring *R* are in the vertical (neutral) position in Fig. 2. If input shaft turns socket ring *R*, cylinder barrel *B* turns with it, but the pistons have no motion in their cylinders. Turning control *C* until socket ring *R* takes position *XX* pulls the top pistons farther out of the cylinders and pushes bottom ones in.

With socket plate tilted to *XX* when socket ring and cylinder barrel turn half a revolution, pistons that were on top will be at the bottom and those at bottom will be on top. During this change, pistons that were on top are pushed in as they move to the bottom. Those at the bottom are pulled out as they move to the top. So by rotating the socket plate and cylinder barrel, when the former is tilted, the pistons are moved in and out of the cylinders to produce a pumping action.

Assume you are looking at the drive-shaft end of the unit when shaft turns clockwise. As cylinder barrel and socket ring turn, pistons and cylinders move up on the left and down on the right. This causes the left-hand pistons to pull out of their cylinders and draw fluid into them from valve plate. On the right, the pistons move into the cylinders and force fluid out through valve-plate port into the discharge.

Socket-Ring Adjustment. Amount of pump-piston motion and quantity of fluid pumped depends on socket-plate angle. When socket plate is at an angle of 20 deg with the vertical, pump output is maximum. As socket plate is moved toward the vertical or neutral position, pump discharge decreases, until it becomes zero. By adjusting position of socket-ring *R*, pump discharge can be varied from maximum to zero in infinite changes. Fluid motor similar to pump can be combined with it to form variable-speed transmission, Fig. 1.

High Speed. Pump in Fig. 3 operates similarly to the unit in Fig. 2, but instead of having a tilting plate its socket-ring cylinder block *B* with its pistons, swings at an angle with the drive shaft and piston connecting-rod socket plate *P*. Until pump is running, a spring holds the cylinder-block ported face against valve-plate *V* in which it is supported by a stub shaft in a bearing. Socket-plate *P* is part of drive shaft *S* and is supported in two radial roller bearings and a ball-thrust bearing.

A floating universal-joint shaft *U* connects the cylinder block with the drive shaft and socket-plate flange so they all revolve at drive-shaft speed. Valve plate *V*, against which cylinder-block *B* rides, is fixed in pump yoke, not shown. Two semicircular ports in valve plate mate with passages in pump yoke, which conducts fluid to swivel connections that serve as yoke pintles.

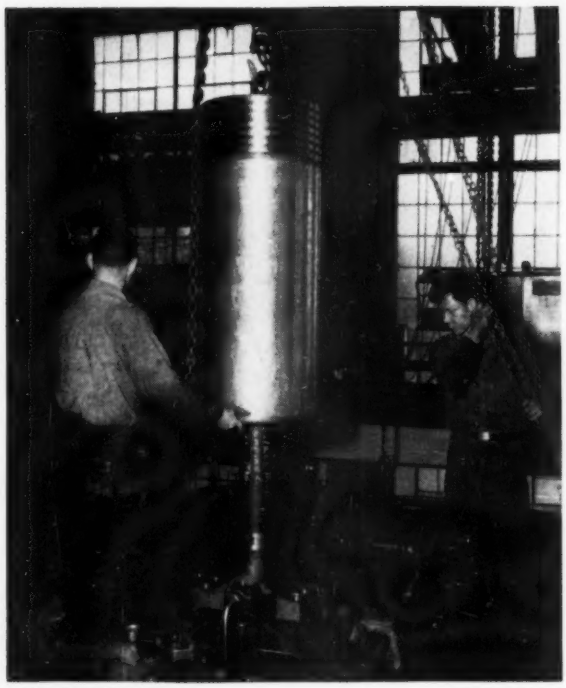
With the cylinder barrel at an angle with drive shaft as shown, the top piston is in full-discharge position and the bottom one on suction. When pump makes half a revolution, bottom piston will be at the top on full discharge and top piston at bottom on suction. Each piston thus functions to create suction during one-half revolution to fill the cylinders with fluid. This is followed by a pressure stroke.

Zero Discharge. If cylinder barrel and valve plate are swung to where face is parallel with the socket flange on drive shaft, the assembly revolves without causing any piston motion. Discharge is zero. Length of piston stroke then depends on angle formed between cylinder block and drive-shaft axis. An infinite range of fluid delivery up to maximum rated capacity can be had by varying angular position of cylinder barrel relative to drive-shaft axis.

Control of pump discharge can be manual by using handwheel *W*, as in Fig. 3, or by mechanical, hydraulic or electric means. Reverse pumping action is obtained by swinging the cylinder block to the other side of the center

(*Continued on page* 210)

PREVENTIVE maintenance is insurance against costly breakdowns, but operator must know an engine well, do his job right



CYLINDER LINER wear depends on operation, lubrication, fuel, materials in liner, piston and rings, and maintenance

19 DIESEL Q and A

By JOHN BAKER
Chief Diesel Engineer

1 Why can a 4-cycle diesel operate well with a higher exhaust backpressure than a 2-cycle unit?

A Reason is that it does not have to depend entirely on the scavenging air pressure to rid its cylinder of exhaust gas to obtain a good volumetric efficiency. Forcible expelling and suction action of pistons up-and-down stroke on a 4-cycle engine will in itself do most of this work with no scavenging assistance.

2 What causes backpressure on a diesel exhaust system? How is it prevented and how does it affect engine efficiency?

A A slight backpressure is always present in diesel's exhaust system because of friction inside piping. This results from restrictions built in passages or from accumulated carbon. Incorrect timing of either intake or exhaust valves is another cause. Removing restrictions from exhaust passages, usually carbon, corrects problem.

Engine efficiency drops in direct proportion to increase in backpressure. Backpressure divided by percentage of effective stroke equals percentage of loss. For efficiency, ½-psi maximum backpressure is about right.

3 What are some problems in starting a diesel exposed to extremely cold temperatures?

A Cold weather makes lubricating oil more viscous, increases cranking torque. Engine temperature may be so low cylinder walls absorb heat of compression before firing temperature can be reached. Because diesel firing depends on high cylinder temperature caused by high air compression, engine may have to be warmed before it starts in cold weather. Tests show that less cranking time is needed if cranking speed is increased.

4 Some operators use very light lubricating oil or add kerosene or fuel oil to crankcase for cold-weather starting. Is this good practice?

A Never do this, for lube oil will be too light when engine reaches operating temperature. And operating temperature should be same, regardless of weather or temperature.

5 What are some causes of diesel valves sticking?

A Too little valve-stem clearance prevents good lubrication. So stems get hot, scuff, gall or seize. Too much clearance allows hot gas to attack oil, causing gum. Too much lubrication at valve stems leaks past guide-end and into high heat zone, causing oil breakdown. Then troublesome deposits follow.

6 How is a 2-cycle engine supercharged?

A Because air is supplied by a separate pump, most 2-cycle engines are supercharged very simply. Only change needed on engine is changing timing of ports or valves so extra air supplied by supercharger is retained in cylinders.

If engine is port-scavenging type with valve-controlled scavenging-air inlet, supercharging is no problem. At times, a rotary valve is fitted in exhaust outlet so exhaust closes earlier and retains air in cylinders.

7 Explain effect supercharging has on diesel engine.

A Supercharger increases amount of air supplied to cylinders. Then same engine can burn more fuel, and more power can be developed. Engines above sea level can only supply rated horsepower by supercharging to make up for less volume of air at high altitude.

Power increases up to 50% are usual with supercharging. Latest turbo-superchargers have increased diesel output by as much as 100%.

8 What are some causes of fuel-injector nozzle trouble?

A Dirt, heat and water are main causes. Minute abrasive particles wear nozzle, valve-seats, stem, and erode or clog nozzle orifices. Dirt is especially bad because tolerances are only one ten-thousandth inch or so. So smallest dirt particles cause trouble between moving parts.

Usually nozzle heats when engine is overloaded for long periods. Then oil forms hard-carbon deposits at the tip, destroying the spray pattern. Deposits on valve seat or valve stem also cause trouble.

Water in fuel corrodes orifices and causes needle valves to stick.

9 How can you tell from engine performance that nozzles are defective?

A Engine smokes (1) under normal operating conditions without being overloaded (2) if exhaust pyrometer in a cylinder reads too high or too low (3) when engine loses power (4) if engine knocks in one cylinder only.

When engine behaves in any of these ways, it's best to remove each nozzle and test in nozzle tester. Reason for testing all of them is that cause of trouble may be present in all cylinders and only time is needed before all nozzles go bad.

10 Describe difference between shunt- and full-flow lube-oil filter for diesels.

A Both filters are installed directly in main-engine lubrication line and all oil from pump passes through filter. In a full-flow filter, all oil pumped through engine passes through filter cartridge.

These filters often have a relief valve, which lifts when cartridge is dirty enough to cause pressure drop to open this bypass relief valve. Some filters have pressure-alarm system to warn operator of dirty filter besides.

Shunt filter is installed in main lube-oil line. Also, it has either built-in or external relief valves. Only about 20% of lube oil passes through the filter cartridge. Pressure drop across cartridge is held fixed by relief-valve, usually from 14 to 20 psi. As cartridge gets dirty, there's more resistance to flow, so more oil passes through open relief valves. Unless filter is changed, engine lube-oil system is contaminated.

11 What is difference between cotton-waste filter and one of fibrous paper?

A There is a fibrous-paper filter, pregnated with resins to prevent water dissolving the paper. One advantage is that paper filter has 3100 sq in. in filtering surface compared with 560 sq in. in cotton-waste type, although both are same size. Paper element in filter is said to last seven times longer than cotton waste and is used for any full-flow-type filter.

12 If sulfur compounds are present in fuel, both sulfur dioxide and sulfur trioxide are formed during combustion. These form sulfurous and sulfuric acids when combined with water. Does each type of sulfur compound in fuel damage engine in a different way?

A No. All sulfur compounds act about the same. They cause formation of sulfurous or sulfuric acid on cylinder walls. Amount of corrosive wear increases with amount of sulfur in fuel. Sulfur-induced corrosion-wear takes place at both high and low engine temperatures. There is more corrosion at low because there's more water and acid condensation in cylinders. For example, at 100-F coolant temperature, top-ring wear rate was 2.7 times as high in one engine, and cylinder wear rate 5.5 times as high as when engine operated at 175-F coolant temperature in test.

13 What are some savings to expect from changing to a heavier fuel?

A Here's report from consultant firm specializing in this field; Rough calculations indicate a small plant with 1500-kw maximum demand, operating at 45% annual load factor, should have maximum saving of $11,000 per year in fuel costs by changing from No. 2 to 4 fuel. About $19,000 can be saved a year if change is from No. 2 to 6.

Changing annual load factor about 45% should bring another savings increase. But actual savings depend on many things, for maintenance costs are higher with residual fuels. Added equipment, such as fuel oil heater, purifier and some changes to engine itself, lower these figures quite considerably.

14 List needed changes to go from a light diesel oil to a residual fuel oil.

A To burn heavy oils: (1) Fuel must be centrifuged and clarified before it can be burned. (2) Fuel must also be heated to viscosity for easy pumping. (3) Set cooling-water regulator so jacket water-inlet temperature is not less than 160-F. (4) Use detergent lube-oil only for cylinder lubrication.

15 List changes usually needed in diesel-fuel system to burn residual oils.

A Pipe a light diesel fuel into system for starting engine. (1) Supply heavy oil after engine gets up to temperature on light oil. Before shutting down engine, run on lighter fuel only, so lines are charged with light oil for quick starting. (2) Centrifuge water and foreign matter from heavy fuel. That means hooking purifier into present fuel system.

16 What effect does heavy fuel have on wearing the liners and piston rings?

A Cylinder and piston rings usually wear faster. Cylinder-liner wear has been all the way from 0.012 to 0.020 in. per 1000 hr, compared to about 0.003 for light fuels. This wear was on cast-iron liners, not those plated with chrome.

17 Diesel valve seats are often distorted. What are some causes? How can they be cured?

A Eccentricity of valve face or seat is from guide being worn out-of-line or from mating faces at axis of guide bore being eccentric. In either case, the valve will leak.

To correct, remove and grind true. Grind both faces and seats with equipment that gives true surfaces. Insert new guide bushings and make sure valve stem is true with valve seat.

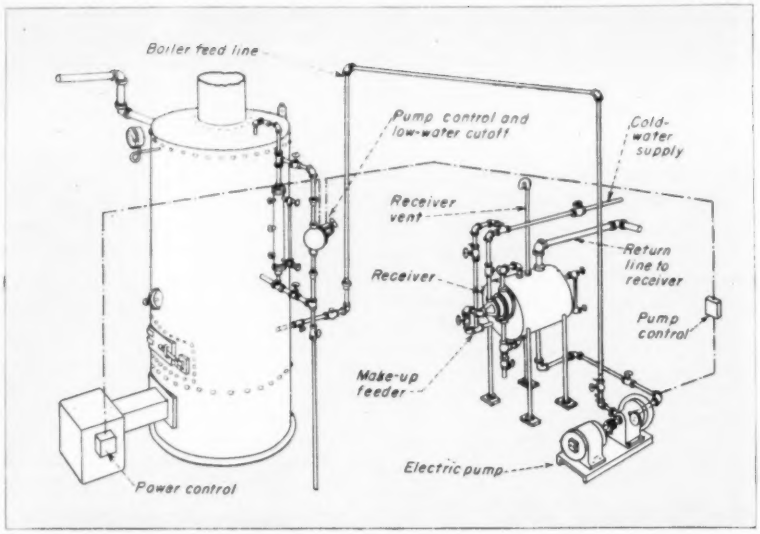
18 Does cold weather have any effect on battery capacity?

A. Yes. Battery capacity decreases about 0.65% per degree F of temperature fall. Battery capacity is reduced 50% when its temperature goes down from 80 to 0 F. Because of this, some diesel operators have auxiliary battery on hand to use as a booster for cold-weather starting.

19 Are roller bearings used for main bearing of diesel engines?

A Yes. Small engines often use straight or tapered roller bearings. Their use is limited to engines with only two main bearings. Reason is bearings can be slipped on over shaft ends only if crank has single throw. Roller bearings have less friction than common babbitt type bearings but are limited because of machinery design.

Survey by National Board of Boiler and Pressure Vessel inspectors blames low-water cutoffs for 38% of reported boiler explosions. Yet equipment is well built, engineered so fault seems to be the user's. Here are some helpful service tips



LOW-WATER CUTOFFS owe reliable performance to good installation. This well-done job has piping short, direct, right size, at correct level with water column

Low-Water Cutoffs Profit From Care

► WHEN BOILERS EXPLODE the usual reaction is to look for operating flaws[1]. But they're not always the cause. Back in January 1952, the National Board Bulletin carried the results of a survey entitled, "Causes of Accidents to Fire-Tube Boilers In Laundries." The survey laid the blame for boiler failures on overheating or burning, 62%, and fuel cutoff failure, 38%.

These results prompted a flood of failure reports to the National Board. So much so that the National Board in its October 1952 Bulletin raises two questions: (1) Would boilers be safer without a fuel cutoff device? (2) Do the records justify safety rulings on fuel cutoffs for power boilers, such as those adopted by many states, municipalities, provinces, and insurance companies?

Actually, the ruling requiring installations of fuel cutoffs on power boilers came about because of (1) the wide acceptance of automatic firing (2) boilers operating with less heating surface and less water storage. All automatically fired, high-pressure steam boilers simply must have an adequate fuel cutoff to protect them against the dangers of low water. Devices on the market that do this job are manufactured by reliable companies, are well-engineered, and should operate satisfactorily. What, then, is the trouble?

[1] "These Five Steps Help Prevent Furnace Explosions," POWER, Oct 1951.

Experience indicates there are four major stumbling blocks that lead to low-water cutoff failures. They are: (1) inadequate range of control (2) improper installation (3) poor operating practices (4) spotty maintenance or complete lack of it.

Inadequate Controls. Certainly you'd expect the average operating man to know and recognize the prime importance of maximum allowable operating pressure on a low-water cutoff. Yet he completely overlooks or fails to check it when he decides on a cutoff. Maximum allowable operating pressure shows on the manufacturer's nameplate, together with the electrical ratings. But many an inspector tells us it's not at all unusual to walk into a boiler room and find the control has been selected on the basis of boiler working pressure, rather than on the basis of maximum allowable operating or design pressure.

For some strange reason this short-sightedness occurs frequently on boilers where the steam safety valve is set for 100 psi or so, but the boiler operates at 35 to 40 psi. Controls are those designed and approved for 50-psi working pressure on the grounds that the normal boiler-operating range lies below this point. As long as the pressure-limiting devices operate—that is, those that start and stop the firing equipment—pressure will always stay below the 50-psi level. But if they fail, boiler pressure can jump rapidly to the steam safety-valve setting.

Under this emergency the low-water cutoff designed for 50-psi service finds itself under double that pressure when you need it most. Chances of getting satisfactory low-water protection are mighty slim.

In much the same way inspectors report electrical switches on low-water cutoffs carry loads way above rating. Because these switches are safety devices and not operating elements, overloads can exist for some time without causing breakdown or false operation of the switch. Yet it's a needless chance to take.

Once again, you'll find the electrical ratings stamped on the manufacturer's nameplate. If a switch is designed for a ½-hp motor you're asking for trouble to hook it up to a full 1-hp motor.

Installation Steps. Over and above the troubles you bring down on yourself by inadequate controls are the ones that result from a poor installation. The sketch above shows a simple installation where a low cutoff has been installed properly. Often inspectors find, while the manufacturer has provided tapped openings for 1-in. connections, the plant man has turned around and reduced them for ½-in. service. True, the control works all right from the start. But remember, it's still new and if the maker felt 1-in. connections were correct, then

Service Tips for Cutoff Care

● Control Ratings must be large enough for the job at hand. This takes in the ones of steam operating pressure as well as electrical ratings.

● Proper Installation ought to be recognized without fanfare, yet jobs keep going in with wrong pipe sizes, incorrect connections, and so on.

● Operating Practices need reviewing. Many plants overlook the value of regular blowdowns, operating checks on cutoff points, resetting of adjustments.

● Maintenance Programming carries so many benefits you'd expect it would cover cutoffs. See that you schedule replacement of operating heads.

why not follow through? Experience proves the 1-in. connections provide the proper equalization, as well as reduce the chances of trouble from sludge build-up. Whatever you do, take advantage of the fuel-size connections the equipment carries.

Note in the sketch that the safety control connects directly to the water column. Also, the connections are as short as possible and in full size. Next, you'll see that the all-important equalizing connections have gone in. The two connections between water column and control reproduce the water line as it stands within the boiler. Any alteration of this piping or inclusion of some favorite gimmick in the connection to the water column can upset the position of the water line in the column and lead to a false reading in the water glass.

Check through these points when you put in a low-water cutoff. See that the water-column setting agrees with the boiler manufacturer's recommendations. Next, check that the lowest visible part of the water glass meets with ASME Boiler Code requirements. Finally, be certain the piping connections to the low-water cutoff insures a true reproduction of boiler-water level.

Remember, make no other connections to the water side of the water column and low-water cutoff, or to the steam side of the water columns and the low-water cutoff. Now and then, you see a small steam-flow line tapped into the steam-equalizing line. With it you get only a false reading. It stands to reason any connection to other auxiliaries changes the pressure-drop conditions in the piping and that change carries back to the water glass as well as the low-water cutoff.

Many manufacturers now tie the low-water cutoff right into the water column to reduce required piping and firmly position the control and water column close to the boiler. Once again, though, it pays to check that the two openings for the water column are in use. Consult Paragraph P-322 of the ASME Power Boiler Code for rules covering proper installation.

Why all the fuss about installation? Suppose the low-water cutoff works only as a safety control and is set to shut off the automatic firing device if the water level in the gage glass drops to ¼ in. of water. If the water column is positioned too low, the firing equipment shutoff may be too late.

Often the low-water cutoff device does double duty and acts as a pump on-off control, too. Then the operating point for the pump-control duty is set higher than the minimum ¼-in. point for safety. Actually, the safety and pump-control features should be planned for separate action. In this way the fuel cutoff still serves as a final safety backup for pump failure.

Operating Practices. Like almost every other boiler auxiliary, the low-water cutoff safety feature can fail miserably under poor operation. All that needs to be done is to blow down the control at least once a day. This removes any loose sediment that accumulates in the equalizer connections or the float bowl. As a matter of fact, most manufacturers recommend a blowdown on the nameplate.

Frequently boiler inspectors report tampering with the adjustments on the cutoff to change operating levels beyond the recommended limits. You can get them so far out of adjustment that the cutoff can't operate.

A periodic check of the cutoff under operating conditions shows this up. You can do it easily enough by valving off the feedwater supply under a minimum boiler load. Then let the water level drop to the cutoff position by normal evaporation of steam in the boiler. You'll find it smart operation to do this about once a month. Should the cutoff fail to respond, you have time to take corrective steps. This operating check reveals not only improper adjustments but unusual solid accumulations, even faulty operation of relays.

Once you do uncover a faulty low-water cutoff be sure you report it immediately. Also notify all boiler-room attendants so no one relies upon the cutoff as a safety device until you're sure it's working properly.

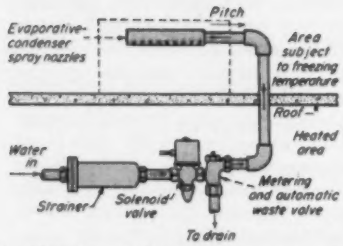
While we're on the subject, inspectors report that operators frequently put in manual controls for their own convenience. The manual lets the operator keep the burner running for purposes of his own even when the cutoff is continually calling for turn off. This is not good operating practice, and you should rip out any such wiring that you come across.

Maintenance. High on the list of essentials for keeping low-water cutoffs performing as you want is maintenance Each time you shut the boiler down for complete washing and inspection, don't forget to inspect all piping attached to the low-water cutoff. Further, remove the operating heads and check the internal condition of the float bowl. Be on the lookout for any scale or sediment build-up here. Scale should never build up. If it does, make sure you instruct your operators on blowdown procedures for daily use. While about it, run a check of the blowoff valves to see that they operate properly or whether any parts need replacing.

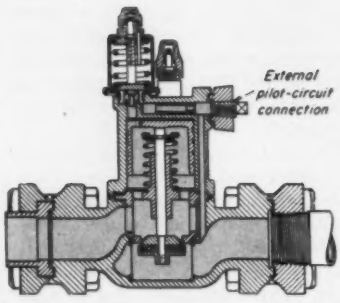
The above procedure holds especially true for those controls serving the double duty of pump controller and low-water cutoff. Remember, this class of control operates continuously and performs a vital function in boiler operations. Not only does it guard against the dangers of low water, but it also maintains the proper water line. A typical boiler equipped with such a combination safety control, running at peak load for at least eight hours and probably more a day, has this particular control working practically continuously throughout the run. Wear is bound to be heavy, and serving as both an operating and safety control its condition is vital to good boiler operation.

It seems shortsighted preventive maintenance to allow so vital a boiler element to run to failure. A program could be readily set up to remove the operating head of a safety device, say the first or second time you shut a boiler down, for general maintenance or inspection. Replace it with a brand new head and return the old to the factory for rebuilding. When it returns you have a spare head for your next boiler shutdown. A program of periodic replacement of the operating head, once a year or every two years, would make preventive maintenance a paying policy.

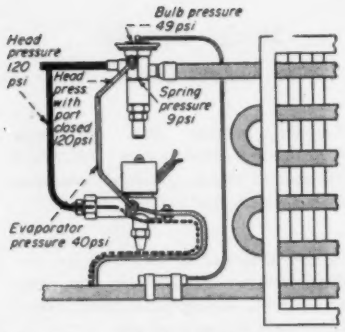
If low-water cutoffs get the benefit of this 4-point planning, look for a sharp drop in boiler explosions due to fuel cutoff failures in plants everywhere.



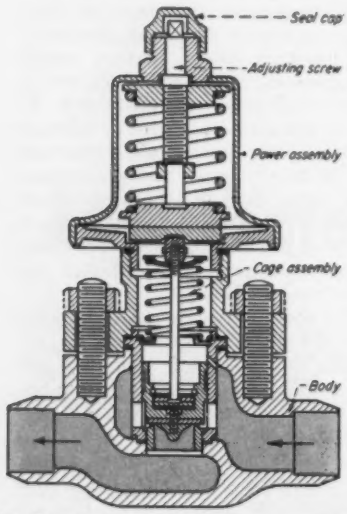
1 Metering and automatic waste valve protects condenser from winter frost



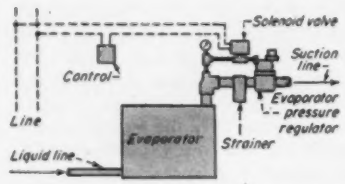
3 Pilot-operated evaporator pressure regulator gives sensitive control


Bulb pressure 49 psi
Head pressure 120 psi
Head press with port closed 120psi
Spring pressure 9psi
Evaporator pressure 40psi

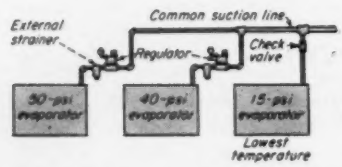
6 Solenoid valve hooked up for liquid-line shutoff service on an evaporator



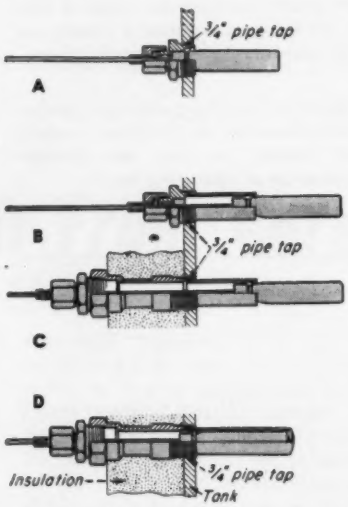
2 Direct-acting evaporator pressure regulator is adjusted from outside



4 Pilot-operated evaporator pressure regulator hooked up for stop duty



5 Multiple evaporator installation has regulators on high-temperature units

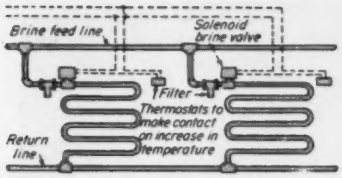


7 Various sleeve and well arrangements for thermal bulbs actuating controls

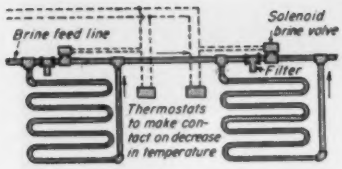
Refrigeration Q&A: Special Control Valves for Your System

By TYLER HICKS, *Associate Editor*

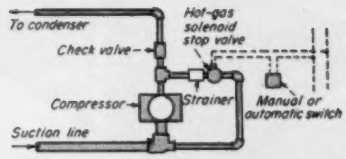
Sixteen questions and answers that help you round out your know-how on specially designed controls for many jobs in the plant. See how the right unit can protect your equipment from many common troubles, make plant operation and upkeep easy



8 Solenoid valves fitted to parallel brine coils serve as automatic stops



9 These solenoid valves on the parallel brine coils bypass liquid if desired



10 Compressor cylinder bypass is solenoid valve connected as shown here

1 What's one way to protect evaporative condensers from winter freezing?

Use an automatic drain valve, Fig. 1. This design has two checks, one for metering flow to condenser, the other for discharging unwanted water in condenser to waste.

2 How does hookup in Fig. 1 work?

When solenoid valve closes, stopping water flow, pressure in condenser line gradually dissipates and automatic valve opens to allow water in condenser to drain to waste. Solenoid valve may be actuated by an outside thermostat, timer or other control.

3 What precautions must you take when installing automatic valve?

See that maximum distance between spray nozzles and automatic valve does not exceed manufacturer's recommendations. Also, pitch from valve so water drains by gravity to waste when valve opens. If some water remains in the equipment there is still danger of freezing in the winter.

4 What is an evaporator pressure regulator for refrigeration systems?

This is often a spring-loaded valve designed to keep evaporating pressure at a constant value. Installed in suction line, valve maintains a preset evaporator pressure for loads up to maximum rated capacity. Smaller units are direct-acting; larger ones are pilot-operated for greater accuracy.

5 How do direct- and pilot-operated controls differ in construction?

Direct-operating valve, Fig. 2, has a manual adjusting screw that is set before or after the unit is installed. Use an evaporator pressure gage to check effect of changing adjusting screw setting. Pilot-operated unit, Fig. 3, has an amplifying piston acted upon by pilot pressure. Piston opens or closes main valve to keep evaporator pressure at constant pressure desired.

6 Can a pilot-operated control act as a suction stop, too?

Yes, if hooked up as in Fig. 4. Here the solenoid valve controls flow in the external pilot circuit. By properly actuating the solenoid valve the evaporator pressure regulator can be closed when desired.

7 How should a hookup of more than one evaporator be made?

Fig. 5 shows a typical application with two "high-temperature" evaporators and one "low-temperature" unit. Common suction line serves the three evaporators. Low-temperature unit has a check valve instead of a regulator.

8 Is a solenoid valve suitable for liquid-line shutoff service?

Yes, if designed for this job. Fig. 6 shows one special valve suitable for liquid-line shutoff service on many different systems.

9 How does valve in Fig. 6 work?

The solenoid valve is connected between the liquid and gas lines and to the under side of the expansion-valve diaphragm. When solenoid pilot-control port is open, liquid passes from high-pressure side through port to compressor suction line. If port is closed, by actuating solenoid, high pressure from liquid line acts on diaphragm's under side to close the expansion valve, shutting off liquid flow to the evaporator.

10 What are the hookup advantages?

Valves designed for this service are smaller and more economical than large capacity solenoid valves. Usually, but one size may be used on any capacity job. Lastly, they give positive shutoff of the liquid line.

11 What kinds of sleeves, extensions, and wells do refrigerant controls use?

Fig. 7 shows four ways of supporting thermal bulbs in a wall. First has a standard ¾-in. demountable union-holding bulb. It screws into a tapped opening in the wall. Where bulb must project further into the tank an extension like that at *B* is used. Bulb at *C* has two extensions, one inside the tank and the other outside. Outside extension allows thick insulation to be applied to tank exterior. Installation at *D* is the same as *C* except that a closed well permits bulb removal without draining any liquid that may be in the tank.

12 How are solenoid valves used in brine systems to control flow?

Fig. 8 and 9 show two typical applications of solenoid valves for brine service. In Fig. 8, valves are used for stops; a thermostat in room or compartment cooled shuts valve to stop flow when desired temperature is reached. Thermostats may be set to maintain different temperatures in different rooms.

With the bypass hookup, Fig. 9, flow is shunted past coil when it reaches desired temperature. Thermostat controls valve operation. In both hookups illustrated, one brine pump serves all coils in the system.

13 Can a solenoid valve be used for compressor capacity control?

Yes, if designed for this service. Fig. 10 shows how the valve is installed in a bypass around one or more of the compressor cylinders. Check valve is used to separate bypassed cylinders from the active ones. Solenoid valve may be controlled by either an automatic or manual switch.

14 What precautions are needed in picking solenoid-valve power supply?

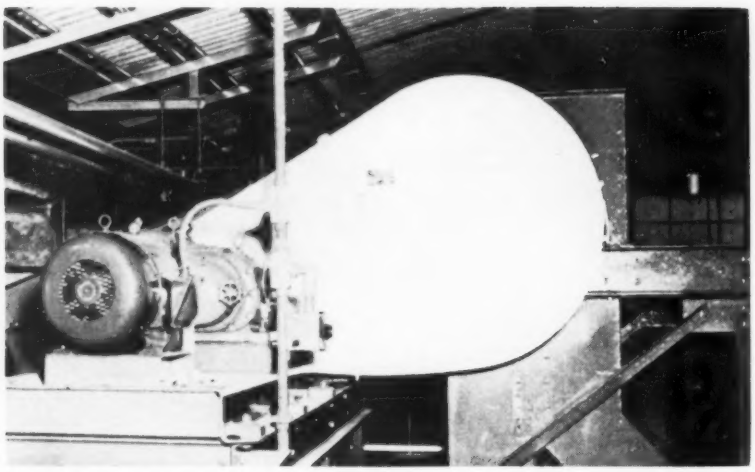
See that power-supply voltage does not vary more than the amount valve manufacturer allows. This is usually 10% over or under rated valve voltage. Avoid excessive voltage drop by wiring valve into a separate circuit, if possible. Never connect valve into a motor circuit because there may be a large voltage drop during starting.

15 Are strainers needed with solenoid valves in refrigeration systems?

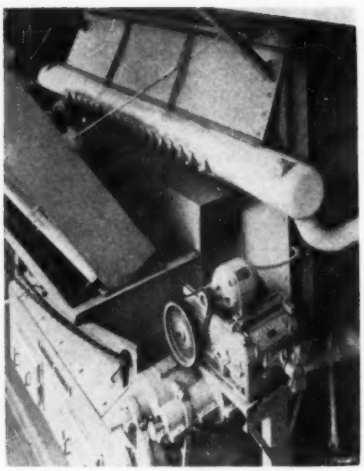
Yes, most manufacturers recommend a strainer with each valve even though there may be a master strainer somewhere else in the system. Be sure the strainer has enough capacity to prevent restricting flow through the solenoid valve. Install ahead of solenoid valve.

16 What's the purpose of a manual-opening stem on a solenoid valve?

It allows you to open the valve by hand if circuit to coil is not in operation or valve coil burns out. The stem is used only in emergency, normally does not interfere with valve operation.



Variable-speed drive controls speed of 42-in. apron feeder-conveyor at base of coal-storage silo. Drive includes the motor, transmission, gear and roller chain



Automatically controlled transmission varies the stoker speed in this plant

Mechanical Variable-Speed Transmissions: V

Here are three final points to consider in applying a variable-speed transmission to your driven machine. This article winds up our series on how these useful work horses do their jobs

By W L BYLER, *North Wales, Pa.*

What Kind of Transmission?

There are three general types of variable-speed transmissions:

Electrical transmissions can provide instantaneous speed change, and you can preset them before starting the drive. When you need either or both of these characteristics, select an electrical variable-speed transmission. Disadvantage is higher first cost.

Mechanical transmissions have been discussed in this series. Use them if there is *time* to make speed changes and if you can make these changes while the drive is running (except for certain all-metal types considered in Part II). Under these conditions, mechanical transmissions are the simplest and most economical installations.

Hydraulic transmissions are gaining in popularity along with electrical and mechanical systems. Use them for unusual operating conditions or where need for other hydraulic equipment offsets installation costs. They entail a higher installation expense, and over-all efficiency is low because there are more components—prime mover, pump, hydraulic motor, valving and, usually, a speed reducer. Other variables like fluid viscosity, operating speed, available system pressure, mechanical and hydraulic friction further affect efficiency.

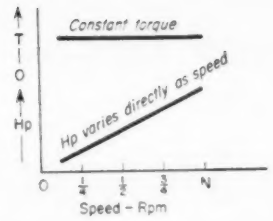
Hydraulic drives are justified when plenty of high-pressure liquid is available or when ambient atmosphere contains explosive vapors, a high percentage of moisture, etc. You can locate variable hydraulic motors remotely and they will operate with little attention.

► To pick out the mechanical variable-speed transmission that's exactly right for your application, consider these three final points: speed regulation, application factors, horsepower-torque relationships.

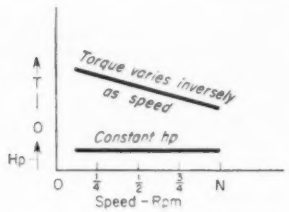
Horsepower and speed-range characteristics, tabulated in Parts II and III, are useful in making the initial survey. Efficiency and ratio changes due to speed and torque, discussed last month in Part IV, are also necessary considerations.

Regulation. In a practical sense, regulation means a transmission's ability to duplicate ratio settings at a particular point after the setting has been changed. This is usually within 0.5% for enclosed transmissions. For closer regulation, belt tensioners and spring-loaded devices can bring this value within $\pm$ 0.125%. But such close control is generally not possible on motor pulleys and floating sheaves.

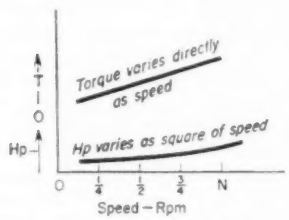
By definition, regulation is the speed droop from no load to full load. To figure percent speed regulation, subtract full-load rpm from no-load rpm, divide by full-load rpm, multiply by 100.



1 Constant-torque applications demand maximum power at maximum speed



2 Constant-power characteristics are needed by lathes and punch presses



3 Variable-torque applications call for higher-capacity transmissions

Table of Application Factors

Operating requirements	Service factor Hours operation per day 8	24
Uniform load, or one or two starts and stops	1.0	1.3
Moderate shock load or infrequent starting	1.3	1.5
Heavy shock load or frequent starting	1.5	1.7
Frequent reversing	1.7	1.9

How to use these factors:

1. Determine the actual horsepower required.
2. Multiply required horsepower by the service factor. Product is an equivalent horsepower.
3. Select a mechanical variable-speed transmission with catalog horsepower rating equal to or greater than the equivalent horsepower.

This is quite different from duplicating some previous setting. It expresses speed-ratio changes due to torque transmitted, as shown in Part IV. Total speed droop (regulation) of the transmissions discussed should be 5%, or under. When arranged as a drive, 8% or less. Generally, we are not worried about the academic concept of regulation except that it should not be confused with efficiency.

Don't expect the impossible of a transmission. Classic example is substituting a variable-speed transmission for a lead screw on a lathe. Unit will produce speed variation at the spindle, but not exact as required. Such a job is in the province of a geared multi-speed transmission.

Consider the problem in terms of the product. For instance, if you are finishing ¼-in.-thick piston rings to +0.0000, –0.0005 in., total tolerance allowable is 0.0005 — half a thousandth. Accuracy must be held to 0.20% (0.0005 divided by 0.25 times 100).

If all variables are produced by the variable-speed transmission, this is within its accuracy limits. But assuming no other variations will almost always lead to grief. The transmission is often the most accurate part of a machine, although it is frequently blamed for all discrepancies.

To sum up, evaluate your problem in terms of the product and in terms of the performance characteristics of each component: motors, gearing, linkages, screw mechanisms, cutting-tool condition, etc. Remember that 0.1 to 0.2% variation is a very small amount of error. It can develop in any one place or a combination of many places.

Application Factors. Some manufacturers recommend using application factors, others do not mention them. As explained last month, most commercial machines are rated below their peak-output capacity. But some carry ratings that seem close to test bench values. In this case, you have to use an application factor even though none is mentioned in the literature. No matter how your machine is rated, using an application factor will assure satisfactory performance, reduce maintenance and prolong equipment life.

There are apparently no standard, official application factors. But experience indicates that the values in the table above are reasonable.

Horsepower and Torque. Most installations require a transmission to operate at constant torque, Fig. 1. This means that power of the driven machine decreases in exact proportion to decreases in its speed. You need maximum power at maximum speed, and should select the transmission on this basis.

Typical constant-torque applications include compressors, conveyors, drill heads, elevators, machine tools, positive-pressure blowers, positive-displacement rotary pumps, stokers, etc.

Some machines need the same horsepower through the entire speed range. This means that driven-machine torque decreases in inverse proportion to increase in speed, Fig. 2. Here maximum power should be computed at minimum speed, and the transmission selected accordingly. Constant power can also include cases where the horsepower curve is not exactly flat, but falls slightly with speed rise.

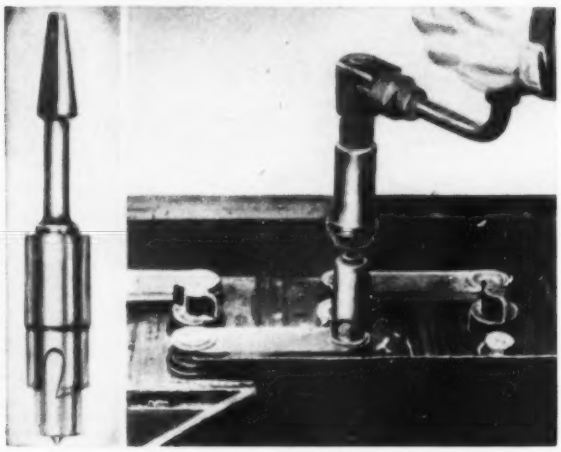
Typical applications requiring constant power are lathes and punch presses.

In a third class of machine, torque varies directly as the speed, Fig. 3. Here the mechanical variable-speed transmission must handle maximum horsepower at maximum speed. Because power varies as the square of the speed you need a much larger transmission than you might expect, and full capacity use is impossible at reduced speeds.

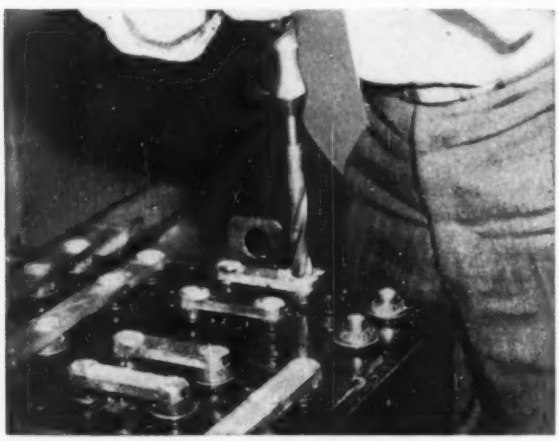
Typical variable-torque applications include blowers, centrifugal pumps, constant-speed and constant-tension winding, unit heaters, ventilating fans. Operating characteristics of these machines are opposite to the rule of torque multiplication or conversion fundamental to mechanical variable-speed transmissions.

Whenever you have the slightest cause to doubt the operating torque-horsepower requirements, base your calculations on torque under varying load conditions and speeds. Do this for every element before and after the transmission. Remember that transmission horsepower-rating must always be equal to or greater than motor rating. When you use service factors to select the transmission, be careful not to apply these factors to the motor as well.

BEFORE: Removing the Cell



1 Special tool drills an annular hole, permits removal of connectors and covers without disturbing terminal post



2 Alternate method of disassembling storage battery is to drill out the posts with an ordinary 15/16-in.-dia drill

3 Cover and element may be pulled simultaneously if cover is undamaged. Clips and chains hold down the battery jar

Follow These Tips...

For Your Storage

► HERE ARE THE STEPS to follow when replacing a cracked storage-battery cover or taking out the cell for general maintenance. The technique is simple—just a straightforward job of cutting, sealing and rebuilding.

Cutting. The hard-rubber battery covers have post openings lined with lead inserts. These inserts are welded to the lead terminal posts to prevent leaks. In a nutshell, the procedure for taking out a damaged cover is to cut out the metal between the post and its opening.

One way is to use a special tool, Fig. 1, that cuts an annular hole around the post. With this tool, the lead posts remain solid, upright and of normal height. You merely lift off the cell connector and battery cover when your hole is deep enough.

The other way is to cut out the metal in the posts with a 15/16-in. drill, Fig. 2. When you get down to 3/8 in., the intercell connector will be free. Drilling down through the cover frees it in turn.

Sometimes the battery is designed so there is clearance between the intercell connector and the top of the cover. In this case you can eliminate the first drilling by making a horizontal saw cut under the connector.

If cover is undamaged, but you want to remove the battery elements from the jar for basic cell repair, remove the intercell connector and lift out both cover and elements as a unit, Fig. 3.

By making a saw cut through the connector above junction-line between battery cells, you do not even have to remove the connector.

The lifting tool can be a post cutter with dull cutting edges or any other suitable instrument. An easy way to hold down the battery jar is with clips and chains, as shown in this photo.

Sealing. To assure a proper seal between cover and jar when reassembling the cell unit, use a good sealing compound and apply it properly, Fig. 4. Battery manufacturers ordinarily supply compound in packaged form, ready for use.

Melt sealing compound over a burner or blowtorch in any metal saucepan or pot with a good pouring lip. Keep temperature at the lowest point that will permit easy pouring, as too rapid heating and too high temperatures cause it to catch on fire. Burning consumes oil and impairs effectiveness. The melting pot should be about one-quart size. Do not use too large a pot because more time will be required to melt the compound completely.

If some compound remains after pouring a seal, it may be cooled, stored and reused. But when it is being reheated, do not puncture the unmelted top layer with a screwdriver or other pointed tool because pressure in the lower melted section may cause hot, melted compound to squirt through the hole. The hands, face or body of persons nearby may be severely burned.

Information for this article, and photographs of the procedure described, were supplied by the Service Department of Guild-National Batteries, Incorporated.

Battery Repairs

Clean the surfaces to be sealed, neutralize with ammonia or baking soda, and dry carefully. Be sure cover is properly seated on top of cell and level with other covers in battery. Pour the sealing compound into space between cover and jar, being careful to avoid spilling. Space must be filled to same level as the other cells so there are no recesses where acid spray can collect. Use a sharp knife to smooth over rough spots, and remove excess after compound has solidified.

Rebuilding. Next step in reassembling the battery is to rebuild the drilled posts. This is a simple "puddling" operation, Fig. 6. Use a carbon electrode to apply heat within the cavity of a simple post mold that can be made in the shop or purchased outside. Take care that the carbon rod does not touch side of mold.

Carbon electrode can also be used for burning (welding) the connections. A carbon burner consists of an electrode holder and a carbon rod. It is designed for 6-v power supply (three cells of a battery), and can use power from the battery being repaired. To insure a good weld, use exactly three cells, as less is inadequate for a good weld, and more actually endangers battery, operator and joint. If battery under repair is entirely discharged, connect the carbon burner to three cells of an adjacent unit.

Rod should be pointed to a $\frac{1}{8}$-in. tip and extended about $1\frac{1}{2}$ in. from the holder. If possible, connect it to the power source so the carbon rod has negative polarity. This makes welding easier as it tends to keep joint and working surface clean.

Lead surfaces to be welded or built up should be neutralized and cleaned with a wire brush. Clean inside hole of connector with a knife, and wire-brush tip of the carbon.

To make a joint, thoroughly heat center of the part being worked until you have a puddle of molten metal. Then add additional lead, Fig. 5, working rapidly to complete the operation before entire part melts. When possible, surround the part worked on with a damp rag. Use molds made for the purpose when building up posts or splicing a connector.

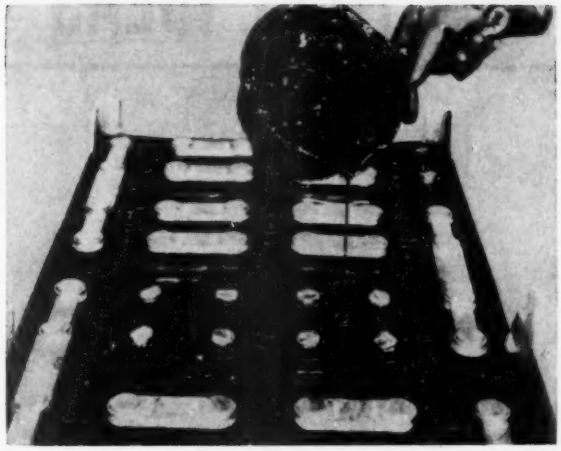
To add new lead, touch it to the carbon rod and let it flow into the puddle rather than plunging cold lead into the puddle itself.

When burning a connector to a post, one slow trip around the post should do the job. This is also true of burning a post to the lead-insert of a new cover. But joint is so deep that considerable lead will be removed from the post in the circuit around the joint. To build it up, return carbon point to center of the post and add new lead to raise post height to level of the top of post mold.

After making the burn, let joint cool undisturbed. Moving it during cooling may cause lead crystallization and result in a poor weld. After cooling, you can determine whether weld has been made properly by testing with a pair of pliers. Joint should strongly resist separation.

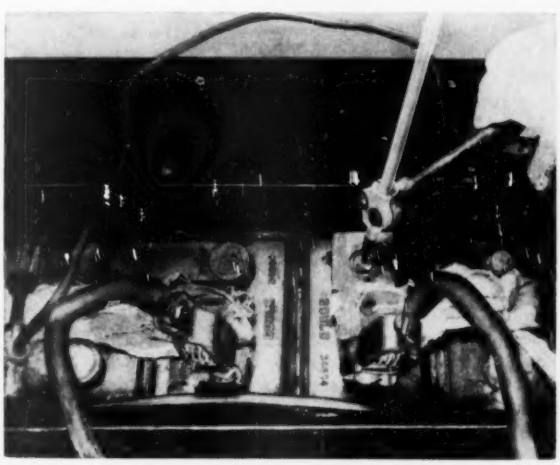
If separation occurs, examine the two surfaces to determine the points and nature of weakness so the situation can be corrected on the second try.

AFTER: Sealing and Welding



4 Pour sealing compound into space between cover and jar. Space must be filled to same level as the adjacent cells

5 Burn joints with a carbon rod connected to three battery cells. Apply fresh lead so it flows into melted puddle



6 Use a mold when building up battery posts, but be careful that the carbon rod does not touch side of the mold

PRACTICAL IDEAS...*here's the trading post for your*

Burning Coal With Sawdust Shows Big Savings

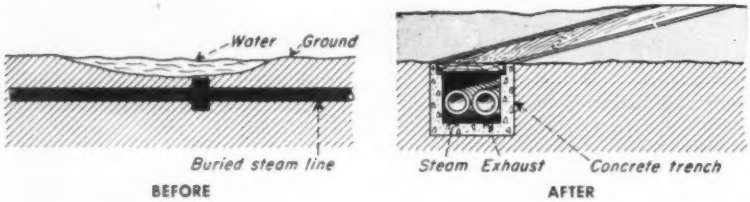
WHEN LESS THAN THREE CARLOADS of coal were on hand at beginning of last major coal strike, Superintendent Kenneth Russell of Sauk County Hospital and Home turned to sawdust. Piles of sawdust were scattered through the vicinity. He not only saved on fuel, but also improved performance by burning this sawdust and coal mixture.

He tried various mixtures. Best luck came from 50% (by weight) sawdust for summer firing, and between 30 and 40% for winter. That depended on load that weather conditions called for. Sawmill operators have found their waste product a drug on the market, also a fire hazard in their locality. Sawdust, however, is on a come-and-get-it-basis.

Figures for period before Jan. 1, 1950 when sawdust burning was begun, show this small plant saves four carloads of coal a year. At average cost of $475 per carload, that's near $2000 a year.

Guy Wheeler, engineer, reports less ash, fewer tube blowings since using coal-sawdust mixture. There has been a slight increase in flyash.

E G GREGORY *Reedsburg, Wis.*



Finding and Correcting Bad Steam Leak

STEAM for eight large lumber-processing kilns was piped through lines half buried in earth. Lines ran under shop floor, with about 2-ft clearance between floor joists and pipeline.

We found a hard-to-believe condition. Two feet of hot water (nearly boiling) lay over and around the pipe. Only way of finding leak was to shut down kilns and let water seep away.

That took three days. We crawled through wet mud to inspect suspicious spots. At each spot we tore up the floor, as nearly above the spot as we could. But we were hampered by piles of lumber stock and machinery on floor above. Then we turned on steam again and tried to localize leaks.

After two or three nonproductive attempts, leak finally showed up. An 8-in. ell had given up the unequal struggle for survival. Local mechanic had remedied the trouble by installing a 6-in. ell in place. He ran nipples from new ell into 8-in. pipe both ways. Then somehow he poured lead around the two nipples, on both sides of ell, something like a bell-and-spigot joint in underground cast-iron pipe. I repaired with standard piping and built a concrete trench with wooden cover.

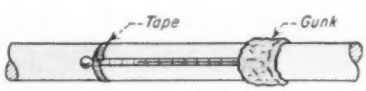
H B MCDERMID *Cincinnati, Ohio.*

Hose Takes Care Of Misalignment

ONE OF OUR PRODUCTS solved a serious pump-failure problem at the Thermoid Co. A centrifugal pump driven by a 15-hp motor supplies 250 gpm of cooling water at 120 psi to conveyor-belt vulcanizers. Intake pipe could not be aligned too well with intake side of pump. So rigid metal pipe and casting on intake side of pump broke often because of vibration and stresses caused by slight pump misalignment.

We replaced metal pipe by a length of suction hose, that's built to take pressures involved. It's flexible enough to absorb misalignment and vibration.

BUCKO JONES *Trenton, N. J.*



Quick Way to Take Pipe Temperature

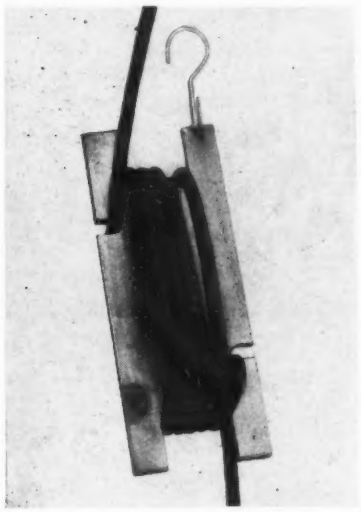
EVER NEED a thermometer in a hurry to check operating conditions? Electrician's "gunk" and thermometer solves problem, sketch.

Pad the stuff to size and shape for job. Place thermometer on pipe in desired spot, and press pad firmly *but gently* around thermometer bulb and pipe. This not only holds thermometer to pipe but acts as a pretty good insulator. Then you read temperature of whatever is flowing in pipe accurately enough for field checks. Don't use this idea on high-temperature lines.

E R ECKERT *New York, N. Y.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

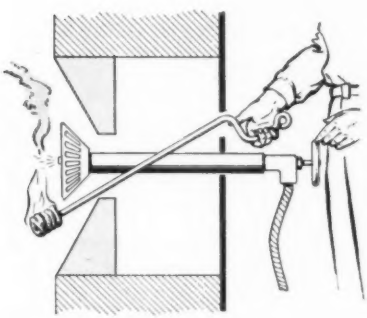


Taking Up Cable Slack

LONG, FLEXIBLE CABLE is a big help for portable power tools like drills. But when long cable isn't needed, it snakes around the floor. That's dangerous.

We take up cable's slack with a simple reel, photo. Reel is made of ⅜-in.-thick wood. Cable is kept from unraveling by locking its ends in grooves. Locking slots are right angle or L-shape grooves. When not in use, hang up.

C T BOWER *London, England*

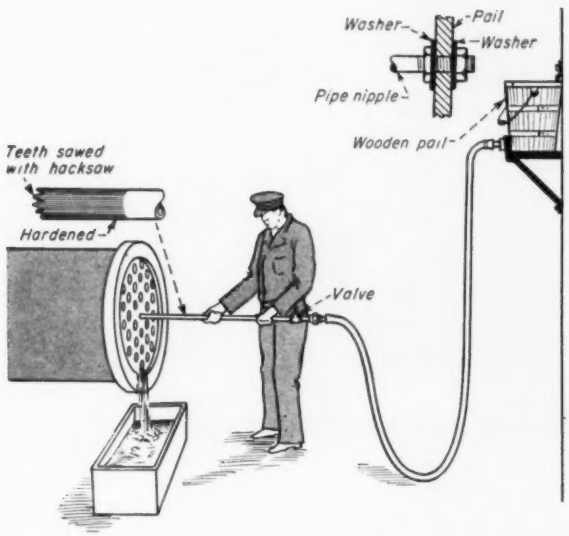


Offset Handle Is Safe

WE HAVE BALANCED draft for our boilers. When fireman secures a boiler because of drop in load he may forget to open uptake damper or "balance float" manually when he lights off again. Reason is that damper does not open quick enough when he lights off first burner.

A fireman burned his hand while holding the torch during a flare-back. I offset torch handle, sketch. Torch now hangs on light-off port without fireman's hand being burned.

L M MARTINEZ *Rego Park, N.Y.*



Acid Lance Cleans Scalded Tubes

WE BUILT an acid lance to remove stubborn scale from water heaters, condensers, and similar heat exchangers. Acid is saved, surface deterioration retarded, and tough cleaning jobs are done with a little effort. Completely plugged tubes are often cleared.

To make lance to clean ¾-in. tubes for a hot-water watertube heater, use ⅜-in. standard black pipe, two feet longer than tubes. With hack saw, cut teeth in one end as shown. Thread opposite end.

Then caseharden the teeth. Just heat metal red hot with acetylene torch for a distance of two inches. Shut off the oxygen, and use pure acetylene flame that covers the glowing metal with a heavy coating of carbon soot. Before pipe loses red color, quench in water.

Thread pipe into a ⅜-in. brass globe-valve, having a composition rubber seat. To opposite side of valve, assemble a 6-in. nipple and union, followed by a short nipple, reduced to fit inside a ¼-in. rubber hose.

For acid supply, drill a hole on side, near bottom of a 16-quart wooden pail. Screw a long-threaded nipple into this hole and fasten it securely. To do this, slide close-fitting flat metal washers over each end of the nipple, and use electrician's lock nuts to force them tightly against the side of the pail. Coat the inside of container with hot pitch or asphalt. Be careful not to plug pipe.

Hang acid pail on hook from ceiling, or place on a wall as shown. Then fasten free end of ¼-in. hose to nipple.

When using lance, an inhibited hydrochloric acid is best for most scales. Lacking an inhibitor in acid, one part of acid to four parts of water gives good results without harm to metal. Use a small trickle of acid while working lance to loosen scale.

A few ounces of inhibitor added to a 100-lb carboy of acid is about right.

H N JOSLEYN *Fort Dodge, Iowa*

EDITOR'S NOTE:—*Caution: Make sure acid container is fastened to wall so it cannot be upset on someone. Also, be sure only responsible person does this job or damage will be more than good gained from cleaning with acid.*

Watch Those Light Metal Ladders

ALLOYS OF aluminum and magnesium are light and resist moisture. When overloaded, unlike wooden ladder, there's a deflection warning instead of sudden break.

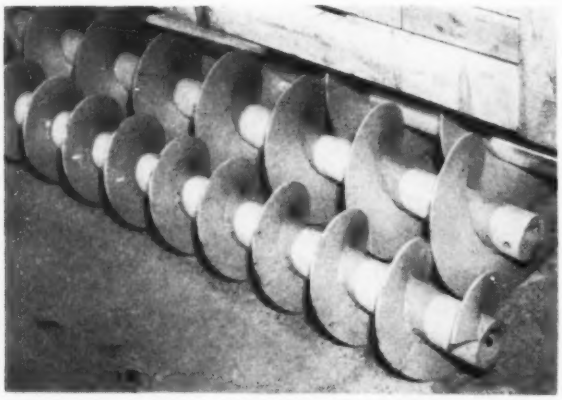
But you must examine metal ladders for sharp edges and burrs on the side rails. Also for soft metal rivets that might shear off under load. Remember, metal ladders are conductors of electricity. Never use around electrical equipment. Have a painted warning attached to all metal ladders. That's the only way to prevent accidents.

—NATIONAL SAFETY COUNCIL

(*Continued on page* 126)

More PRACTICAL IDEAS

Begins on page 124



Enameled Coal Screws Save Dollars

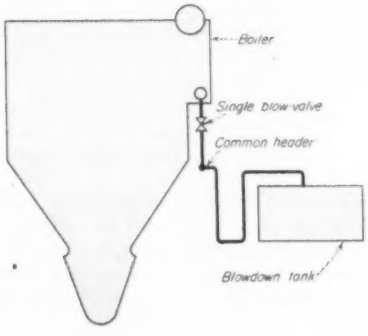
OUR THREE 450-HP and two 250-hp boilers burn coal. We had a troublesome corrosion problem a few years back in conveying coal from storage hopper to boilers. Sulfur in wet coal formed sulfuric acid, attacking the screw conveyors and housings. Screws lasted only three months.

First, we used rubber coating. But although life of spirals was extended, cost was high and friction increased. Then we tried industrial porcelain enamel. Both the spirals and housings were sent to the Erie Enameling Co.

They applied a high-gloss, acid- and impact-resistant enamel. Screws have been in service for 1½ years. Besides, less horsepower is needed to operate conveyors. All new conveyors are now enameled before installation. And, when bare steel begins to show, we take conveyor out and send it to Erie for a new coat. Thus we get the equivalent of a new conveyor for one-third the cost of a new one. And with less outage time.

BOB HEDGES *New York, N. Y.*

Stops Water Hammer in Blowdown Line



WE HAD TROUBLE with boiler blowdown system. Each time that any one of our boilers was shut down before midnight, there was water hammer in blow lines early next morning. Water hammer was not severe at first, but became louder and louder until it was pretty bad.

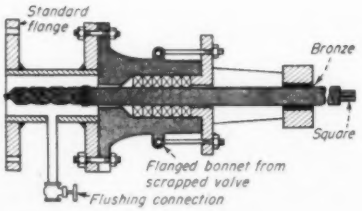
Boiler blow-valves are old-fashioned, gear-lift, solid-disk, single-valve type and were no longer tight enough to seal boiler water after frequent open-and-closing. Lines with leaking valves were much hotter than others.

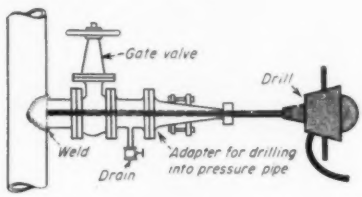
Load condition was such that we didn't have chance to regrind valves last season. As we were short of valves, neither could we replace them nor could we install new seal valves beyond them.

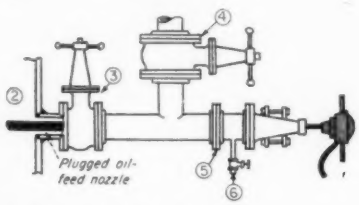
Inspecting blowdown system, we found trouble. Blowdown line of each boiler was connected to a common header and common header went to top of blowdown tank. System thus made a large U-tube working as dead pocket for condensate. So repeated flushing and condensing cycles of leaking boiler water pushed, then drew back water column in dead pocket. Result was a series of water hammers, sketch.

We cut a hole in bottom of common header, welded a piece of pipe, installed a ¾-in. valve, and led the pipe to ash trench. By opening this small valve to drain common header, water hammers eventually stopped bothering us.

H C WU *Taipei, Free China*







Drilling Into Lines Under Pressure

HERE ARE plant-tested methods for drilling into lines or vessels under pressure. Most adapter parts are from scrap.

Top sketch shows adapter. We used this for putting a 2-in. connection on a 12-in. gas-oil line. Actual drilling took 10 minutes. Drill was 1 47/64 in. No trouble of chips getting under valve because 1-in. flushing connection is to get rid of chips.

Drill ⅛ in. smaller than ID of pipe. Pressure drop across orifice opening is negligible even in high-pressure vessels.

To make adapter in top sketch: (1) Weld nozzle to pipe that's to be tapped. (2) Fasten gate valve and drill equipment shown.

Second sketch shows adapter hooked up, ready for drilling. To drill: (1) Open gate valve, then drain line. (2) Start drilling. (3) After drilling through pipe, pull drill clear of gate valve and shut off. (4) Remove drilling equipment, and hook up piping.

Bottom sketch shows method of cleaning out plugged-up feed nozzles in the reactor of our fluid catalytic refining unit: (1) Close valves 3 and 4. (2) Remove blind flange at 5 and fasten drilling equipment. (3) Insert drill and open valve 3. (4) Drill out plugged nozzle and flush out as necessary with valve connection 6. (5) Pull drill clear out of valve 3 and shut valve 6. Install blind flange at 5, open valves 3 and 4.

S B MORO *Montreal, Quebec*

(*Continued on page* 128)

The RIGHT DRAFT for Any Combustion Condition

...Stepless, Wide Range Speed Control of Direct Coupled Draft Fans

When Type 257 Liquid Rheostats control the speed of boiler fans driven by wound rotor motors you get:

- Immediate response to varying draft conditions.
- Smooth, continuous, *stepless* speed control.
- Equal sensitivity over the entire operating range.

HOW IT WORKS. Motor speed is varied by increasing and decreasing resistance. This is accomplished by raising and lowering electrodes and the level of current-carrying electrolyte. A pilot device transmits draft condition to a lifting mechanism which controls electrode position and electrolyte level. A full resistance range is provided in only 10 inches of electrode travel. The basic principle of liquid rheostat operation plus the utilization of specially engineered electrodes gives a linear relationship between motor speed and electrode travel over the complete rheostat range.

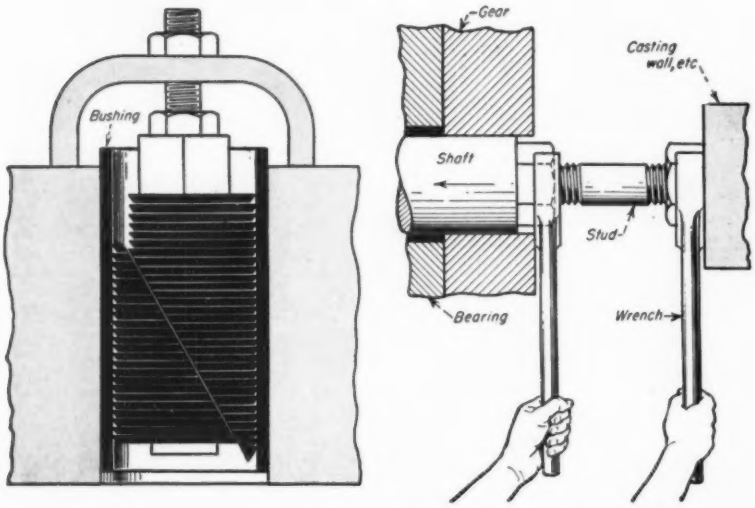
Since the rheostat is not mechanically connected to the motor it may be located to suit the most convenient plant layout. For complete details, contact your Allis-Chalmers representative or write for leaflet 14S7544. A-4066

ALLIS-CHALMERS

Milwaukee 1, Wisconsin

More PRACTICAL IDEAS

Begins on page 124



Bushings Must Come Out Now—'Or Else'

EVERY OPERATOR has sweated for hours over a stubborn bushing that wouldn't budge. Besides being in tight, a bushing is often in a spot you can't get at, let alone swing a hammer. That's why I made the puller shown here.

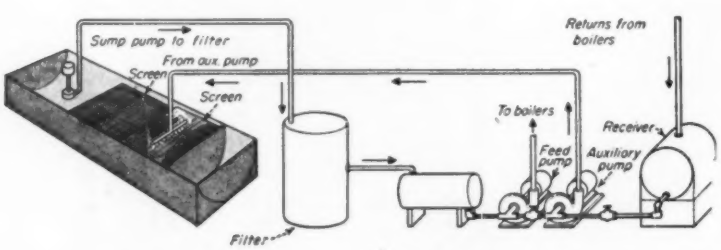
Puller is made of two rounded wedges to fit inside the bushing. Rounded outside has sharp-edged grooves for digging into the bushing. By making wedges of tool steel and then hardening and tempering edges, tool remains sharp and digs into any bushing metal.

Left-hand wedge has large hole through center so it does not bind bolt and can move sideways, away from right-hand wedge.

To use, place puller inside bushing, then tighten nut to expand wedges against bushing's sides. Place yoke and nut over bolt. If tightening nut on top of yoke won't pull bushing out in one piece, I don't know of anything that will do the job.

Another handy gadget for removing a shaft from a gear is made of two nuts and a stud, right-hand sketch. It's just a case of having a solid wall or something to anchor the stud against.

W B KENNEDY *McCool, Miss.*



Old Boiler Makes Feedwater Filter

WHEN OUR LOAD doubled last year, we had to put an extra boiler into service. Then we used twice as much cylinder oil as before. Strain was too much for filter. We got oil back in the boilers.

At first it looked as though we'd have to change the filter chemical more often, but that was an expensive job (12 bags for each change at $20 a bag). We found a way to beat the rap.

We took one old condemned boiler and cut it through the middle. Then we welded in three baffle plates, sketch.

In two sections formed by baffles, we put charcoal and covered it with screen. Screen frames are from old ¾-in. galvanized pipe, screens are ⅛-in. galvanized wire mesh. Next we installed a sump pump in third section to lift water to the filter. Pump is submerged type.

Boiler was left on its old setting. We used old boiler-feed line and made our connection to auxiliary pump supplying the filter.

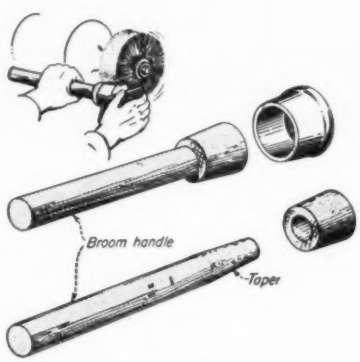
Now water from buildings enters receiver and is pumped by auxiliary feed pump to filter. There it enters first section, and works its way down through charcoal to second section, where it's filtered some more. Then it overflows into third section. Biggest part of oil is removed in first two sections.

Sump pump sends filtered water to the filter deoderized for its final purification. From there it is fed to the boiler-feed receiver for use in boilers.

We change charcoal twice a year at cost of $1 per change. Net cost of installation was $170.80. Cost of replacing chemical twice a year would have been $480. Our present cost per year is $276, or a saving of $204.

Installation paid for itself in one year —we get no oil back in boilers.

R BOGUE *Mount Hermon, Mass.*



Wire Wheel Cleans Taper Plugs

HERE'S AN EASIER and faster way for cleaning a tapered plug than shown in Operators' Notebook No. 63. We call this the spin method. If you have buff wheel-stand, it's easy to take plugs to wheel. Fit hand holer or spin-stick inside plug and use as shown.

Put hollow plug on spin-stick. With a pad in your hand, hold plug lightly against spin stick and apply against wire wheel. This causes plug to rotate on spin stick. Plugs clean quickly and thoroughly with no flat spots.

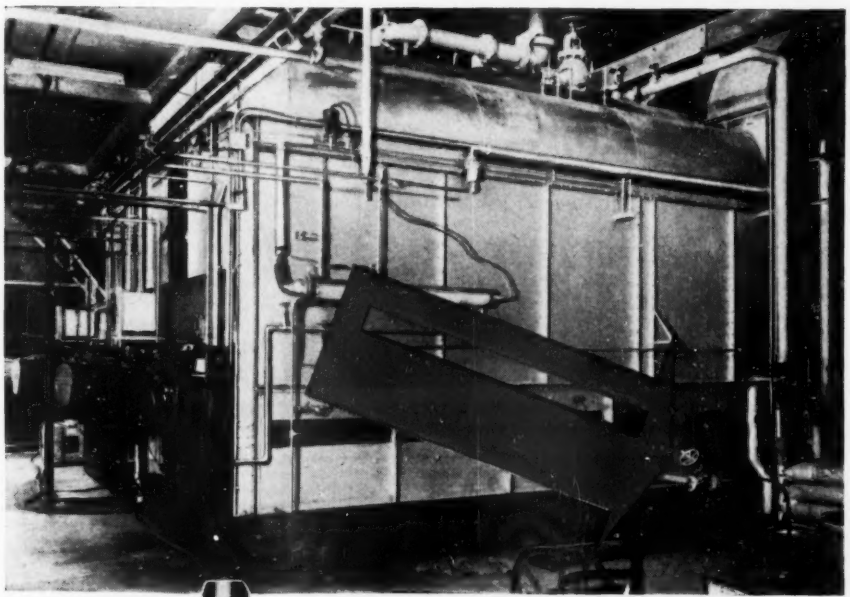
C H WILLEY *Pennacook, N. H.*

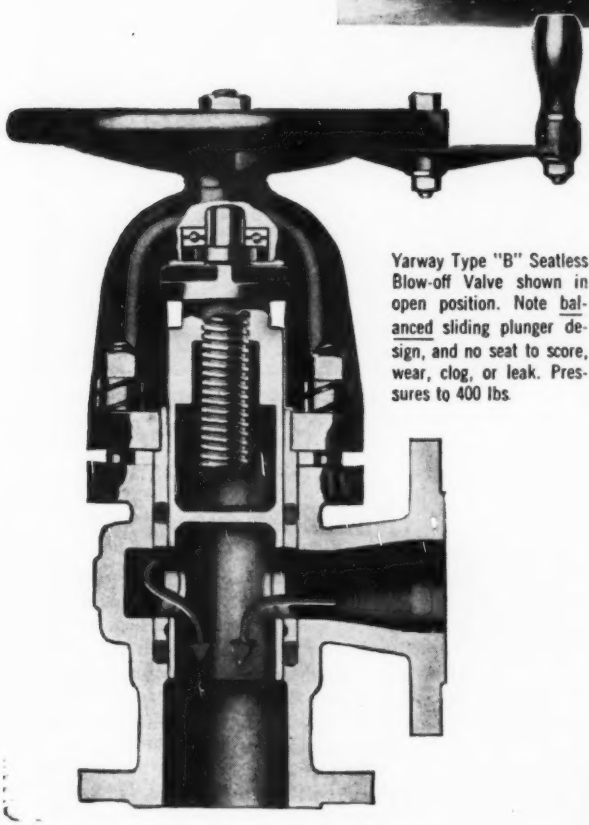
Wall Fountains

ONE ELECTRIC WATER COOLER is piped to four drinking-water wall fountains in our plant, saving that many coolers.

G A WELLS *Sioux City, Iowa*

THIS ERIE CITY "PACKAGE" INCLUDES A YARWAY SEATLESS





Yarway Type "B" Seatless Blow-off Valve shown in open position. Note balanced sliding plunger design, and no seat to score, wear, clog, or leak. Pressures to 400 lbs.

■ The above installation of two 300 hp. Erie City VL type boilers at a Detroit automotive plant shows Yarway Seatless Blow-off Valves as part of the "package" picture.

Good package-type boilers are *better* when equipped with Yarway Blow-off Valves.

Get the advantages that have made Yarway Blow-off Valves guardians of blow-down lines in more than 15,000 boiler plants. On your package boilers—whatever the make—high grade blow-off valves pay off in dependable, trouble-free service.

Write for Yarway Bulletin B-426.

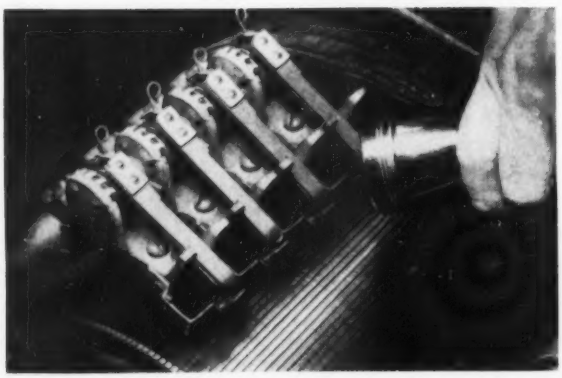
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY®

SEATLESS BLOW-OFF VALVES

PLANT PROBLEMS... *put your know-how to work*

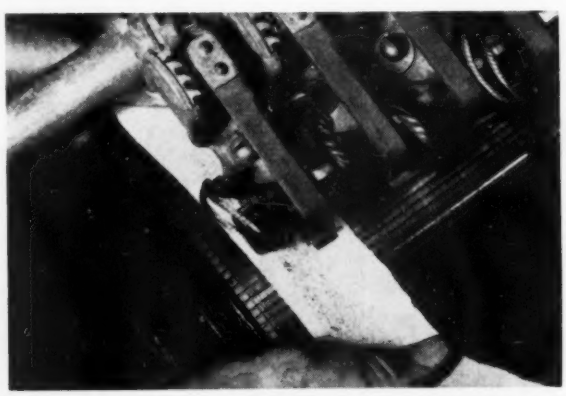
What Causes These Burn Spots on Bars?



1 Inspect the brush holders inside and out for burned spots that may have been caused by flashing at the commutator

2 Be sure shunts are properly secured to the brushes and the holders. Poor connections cause burning, wear, heat

3 When installing the brushes, make sure they can move freely in the holders. But watch out for excessive side play



4 Fit the brushes to the commutator one at a time with a strip of sandpaper, first using coarse paper, then fine

Here Is the Question

THE FACTS FROM JUNE POWER: Commutator on 25-hp 6-pole 70-rpm dc shunt-wound elevator motor has six equally distributed burn spots, corresponding to the brush spacing. Each burn covers an area of four commutator bars, and begins to appear a few days after the commutator is resurfaced.

We've had this trouble since we replaced a few coils several years ago. Believing the coils caused it, I checked them repeatedly without results.

When elevator ascends, no sparks occur, but slight sparking appears when it descends. There is somewhat more sparking during starting and stopping. We have several other machines, and though they spark there are no burns. How can we cure this trouble?—*VN*

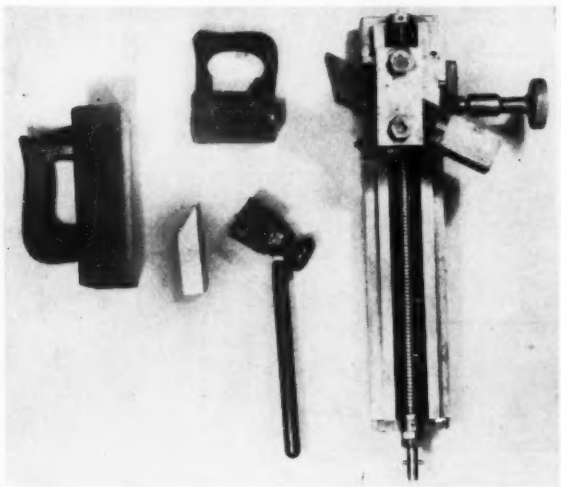
Now Read the Answers

FOR TOPNOTCH commutation, brushes must be correctly installed. Photos, above, show procedure that works on most of my jobs. Before inserting your new brushes, be sure inside of holders are smooth. If rough, sand with a piece of fine sandpaper glued to a flat piece of wood.

Make sure shunts are properly secured to the brushes and holders. If connections of the shunts are defective, current will flow from sides of brushes

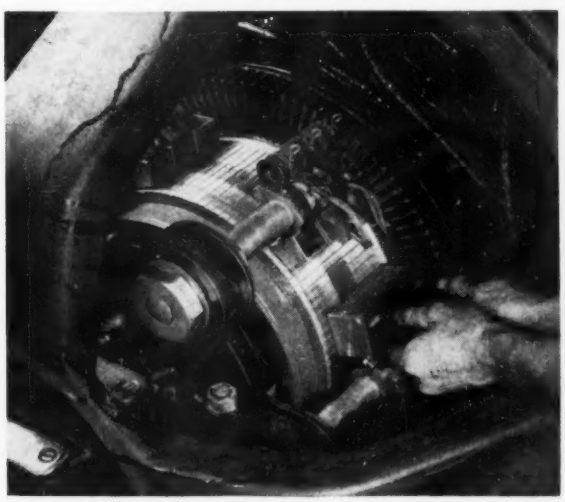
help the other guy cure his headaches

TYLER HICKS, *Associate Editor*

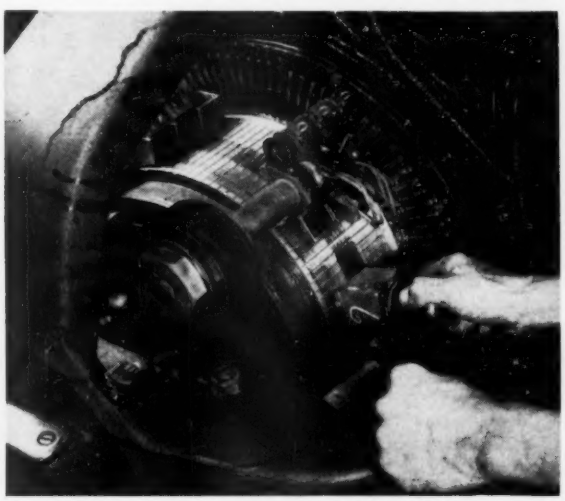


1 Tools for commutator stoning consist of several hand stones and a traveling steady-rest. Small stone is for close job

2 Stone mounted on steady-rest is for badly grooved commutators. Set the steady-rest with a 1/32 in.-to-ft taper



3 When commutator needs only a small amount of stoning or you don't have a steady-rest, use a hand stone as shown



4 Small stone with knob and removable handle for small commutators or for use where the accessibility is limited

into the holders and cause side-burning, wear, overheating and poor brush operation.

Don't have brushes so loose in holders that there is appreciable side play. Allow enough clearance for brushes to expand without sticking at their operating temperature.

Fit brushes to commutator, one at a time, with a strip of sandpaper, first using a coarse grade and then a fine one, with the sand side turned to the brush face. Thoroughly clean brushes and holders before running motor. Adjust tension springs to about 2 psi to hold brushes on motor commutator.

Second set of photos, above, shows how you stone a commutator that is burned, grooved or roughened from sparking or abrasive action. Stoning often saves removing the armature and turning commutator in a lathe.

When stoning, lift all brushes away from commutator. Use an external power source to turn motor. Be sure to remove all traces of oil or grease from commutator before stoning. Work the hand stone back and forth several times to insure a smooth, true surface. Move steady-rest stone across surface several times to avoid tapering commutator from stone wear.

After stoning, smooth commutator with 2/0 or 3/0 sandpaper, then polish with back of paper. Be sure commutator and armature are clean before starting the motor. Remove all traces of copper, carbon and abrasive dust with a vacuum cleaner.

JIM SPARKS *Spokane, Wash.*

TRUE COMMUTATOR, without high or low bars and correct mica clearance, will spark if coil leads run to wrong

(*Continued on page* 132)

Begins on page 130

commutator segments. This can cause excessive sparking. Check by setting each coil in a neutral position and see if leads are shorted by the brush. If leads aren't shorted, shift brush position or change coil lead connection.

Wrong interpole polarity also causes sparking. Test by shifting brush and noting direction of rotation. Correct position of brushes in an interpole motor is found by turning armature so one coil lies midway between main poles or directly under an interpole. Then trace leads from coil to commutator, if possible. Or if motor has factory markings for correct position, use them to set brushes correctly.

Chances are lead connections were incorrectly made at time of coil change. This is easy to do when you have a number of leads pulled out at the same time. Always use care when reconnecting.

A R ECKERT *Mt. Vernon, Ill.*

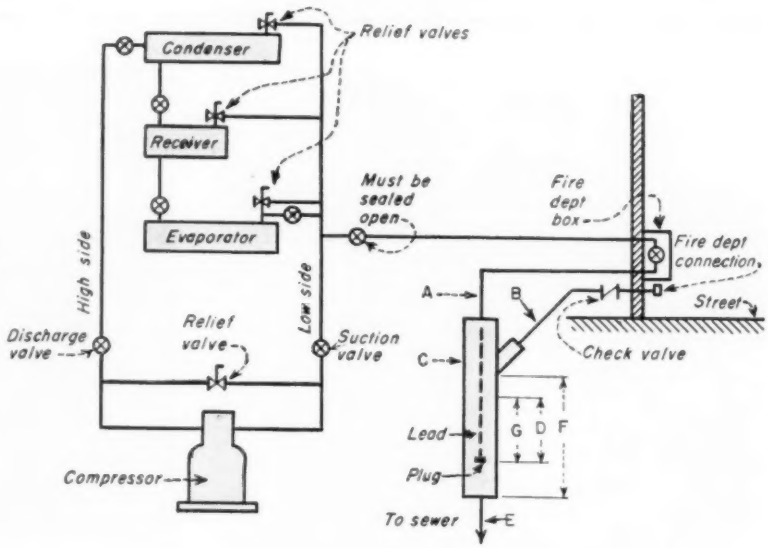
HERE ARE NINE CURES for *VN's* trouble, together with their possible causes. Sparking causes commutator burns, so best method of attack is to find the sparking cause and cure it in a hurry.

Roll and grind rough commutator surfaces to obtain the desired finish. If commutator is out of round, turn and grind it true.

Look for one or more commutator bars that loosen at high rotative speeds. Tighten loose bars, grinding and turning entire commutator if necessary. Undercut high mica. See that brush pressure is sufficient to prevent "bounce." Adjust spring pressure according to manufacturer's recommendations.

Check to see that brushes are not stuck in their holders, and that shunts are tight. If original brushes have been replaced, the new ones may be the wrong type. Remove any dirty film that may have accumulated on commutator surface. It is always undesirable.

A J BREUGELMANS *New York, N. Y.*



Tonnage of plant	Inches						3/32" holes
	A	B	C	D	E	F	G
30 - 60	3/4	1 1/4	4	15	2	45	150
60 -100	1	1 1/4	5	15	2	50	260
100-175	1 1/4	1 1/4	6	20	2	60	460
175-250	1 1/2	1 1/4	8	25	2	75	625
250-450	2	1 1/2	10	30	2 1/2	90	1000
450-900	3	2	12	40	3	120	2200

What's Best Way to Remove Ammonia in Emergency?

HERE ARE THE FACTS: We have 2000 lb of ammonia in our refrigerating system, which serves a large cold-storage plant. Because we have a large number of employes in the basements we need some quick way of disposing of this ammonia in an emergency.

We have adequate water supply from an outside source as well as a 50,000-gal basement storage tank. What method, if any, could we use to mix this ammonia with water in the storage tank, or mix it and then discharge it to waste? We'd like to be able to get rid of the ammonia in about 10 minutes.—*TS, June Power*

Here Are the Answers on Removing Ammonia

NEW YORK CITY rules for ammonia disposal are interesting and may help *TS*. Here is a general outline; for specific wording, refer to *Administrative Code*.

Low-pressure side of ammonia systems having 1000 lb or more of refrigerant must have a hand-operated valve for discharging ammonia into water through a mixer to the sewer in emergency. Mixer should be steel to withstand a pressure of at least 50 psi.

No valve is allowed in the ammonia emergency-discharge line except the manually operated valve discharging into the water and ammonia mixer. But one stop valve may be inside the building for repair purposes. It should be sealed open and labeled, "Keep Open."

A manually operated pressure-relief valve should be located in a locked box, which can be opened by fire-department members. Door of box is on a public thoroughfare so it is easily accessible. Box is labeled for positive identification.

A single, standard, 3-in., fire-department connection is provided, through which water may be supplied the mixer. Check valve between connection and mixer prevents flow of ammonia gas to the street. Systems having more than 27,000 lb of ammonia must have one additional mixer for each 27,000 lb or fraction of it. Sketch above shows important details of required hookup.

JOHN J GEIST *Brooklyn, N. Y.*

(*Continued on page* 134)

Wherever Drip, Splash or Squeeze-out Is a Problem

Use SUNTAC

Suntac Oils stay put, leave no gummy residue. They are ideal for lubricating gears, sprockets, chains, cables, couplings, linkages and bearings where throw-off must be avoided. Call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. P-9

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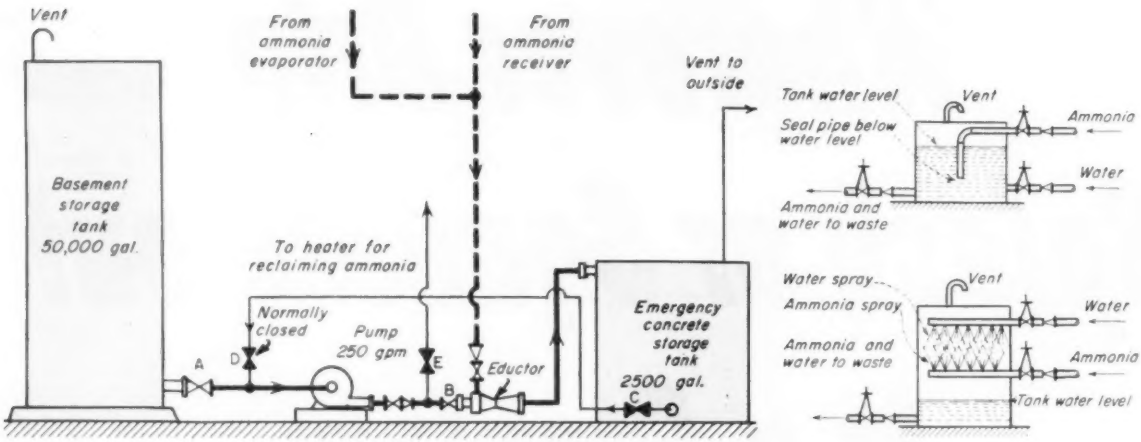
More PLANT PROBLEMS

Begins on page 130



BOTH GAS AND LIQUID must be handled by disposal unit if best results are obtained. Sketch shows one method.

Gas from evaporator and liquid from receiver are piped to a common line connected to an eductor. Centrifugal pump transfers water from basement storage tank and discharges through eductor into a 2500-gal emergency tank vented to the outdoors. Mix one gallon of water with one pound of ammonia in the eductor. Keep tank vent away from building windows, other openings.

By using an emergency tank, *TS* can reclaim the ammonia when the emergency ends. To do this, close valves *A* and *B*; open *C*, *D* and *E*. Pump mixture to a waste-heat exchanger for ammonia removal from the water. Pipe ammonia from exchanger to compressor.

New equipment *TS* needs includes the pump, valves, eductor and concrete tank. Pump, valves and eductor should be cast iron.

Of course, *TS* could dump the ammonia-water mixture into an underground sewer or river instead of a tank. The ammonia, however, could not be reclaimed and local water authorities might object. Best location for ammonia-storage tank would be outdoors.

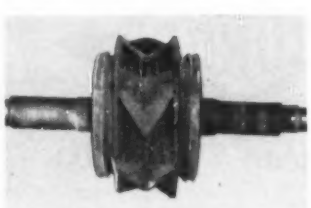
A J Breugelmans *New York, N. Y.*

SKETCHES show two ways of disposing of the ammonia. In the first it is piped to the water-storage tank through an inlet pipe that terminates below the water surface, providing a water seal to prevent escape of ammonia gas.

Fit a gate valve to ammonia feed line to permit isolating gas from tank. Check valve in same line prevents backflow of gas if line pressure goes below the vapor pressure of the ammonia-water mixture, or if tank water level rises too high. Fit tank discharge line with a gate valve to isolate tank from waste-disposal system. Use a check valve to

(*Continued on page* 206)

YOUR NEW PROBLEMS FOR SEPTEMBER



1 How Do I Stop Pump Casing Erosion?

Our four sea-water circulating pumps are driven by 100-hp 575-rpm induction motors. Lift is about 6 ft, discharge resistance about 7 psi.

Photos show one rotor after six months' use. It is badly corroded and had to be replaced with a neoprene-coated unit. After new rotor was in use one month we removed it for a look. It was in good condition but casing showed signs of severe erosion; it appears that attack on casing is worse than on the rotors in these pumps.

What's best way of protecting these casings? Our plant is a long distance from repair shops, and we'd like to do the work if it's possible.—*MC*

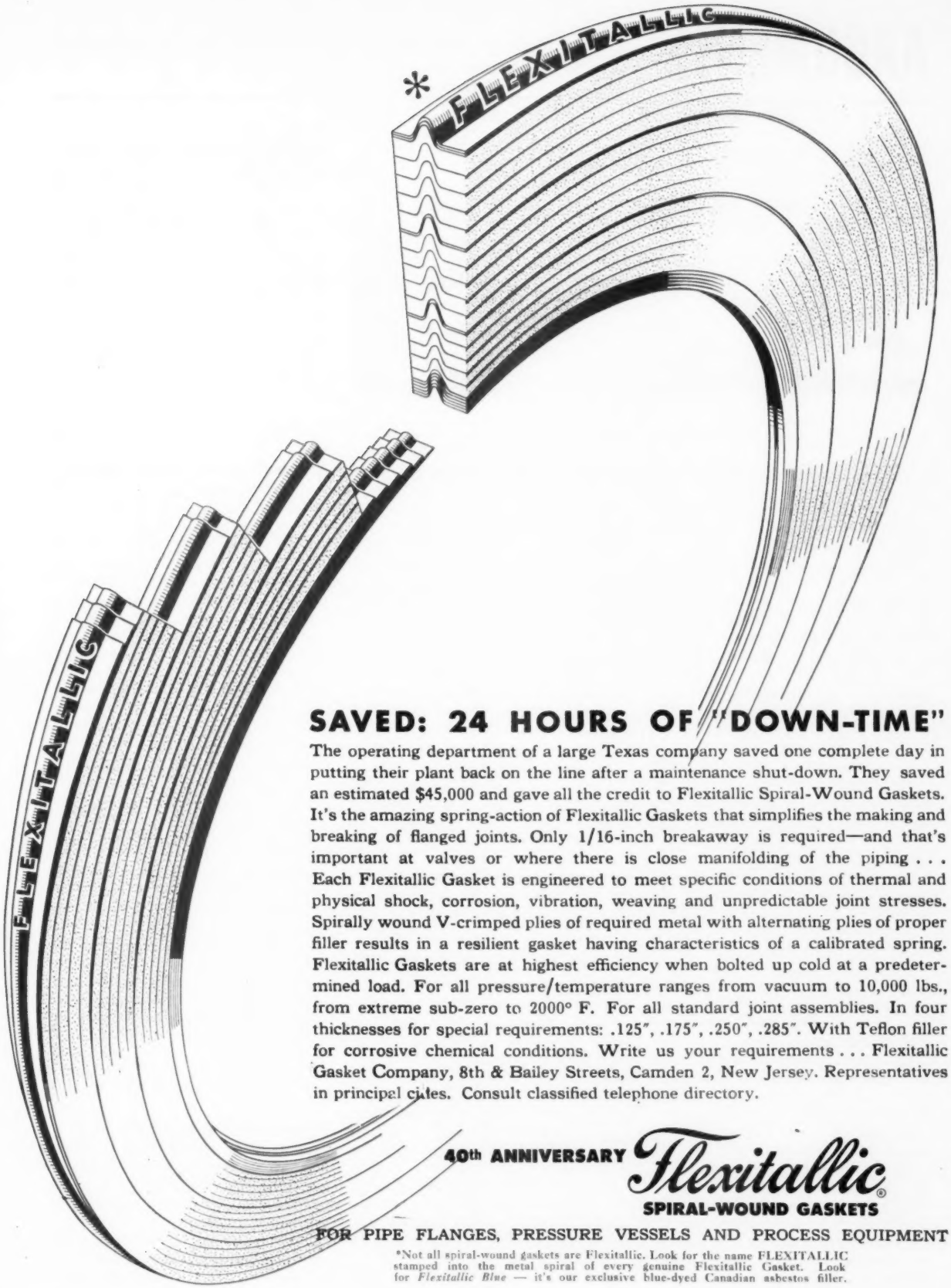
2 What's Best Hookup For This Plant?

We have two 5-ton refrigerating machines in parallel for creamery service. Suction pressure is 25 psi, discharge 170 psi. There's only one expansion valve to serve both machines.

When either machine runs alone we are able to maintain the right suction and discharge pressures. But when both are in use, suction pressure drops to 15 psi.

Is change in suction pressure a result of using only one expansion valve? We have an equalizing line on the high-pressure side of each condenser, and electric hookup is OK. What can we do to maintain a 25-psi suction pressure with both machines running?—*EK*

Will you help readers who sent us problems? Extra pay for photos or sketches.



SAVED: 24 HOURS OF "DOWN-TIME"

The operating department of a large Texas company saved one complete day in putting their plant back on the line after a maintenance shut-down. They saved an estimated $45,000 and gave all the credit to Flexitallic Spiral-Wound Gaskets. It's the amazing spring-action of Flexitallic Gaskets that simplifies the making and breaking of flanged joints. Only 1/16-inch breakaway is required—and that's important at valves or where there is close manifolding of the piping . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

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ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

Swain Sweats, Wife Sails

"SAILING IS wonderful recreation," says Phil Swain, Editor of POWER, "in spite of what happened to me on the rocky west coast of Sweden this summer.

"It was during the midnight twilight. Mrs Swain sailed blissfully on the sloop *Kullan III*, leaving me behind in a dingy. The captain, thinking I was on the towline, started the engine. They moved effortlessly, but I had to use plain oar- and muscle-power trying to catch up. I sweat buckets of perspiration before they missed me."

U.S. Grounding Technique Is Backward

I READ WITH INTEREST H B Whitaker's article, "How to Ground Portable Electrical Equipment" (Jan, p 122).

The technique of earthing (grounding) described is way behind current British practice. Our *Wiring Rules of the Institution of Electrical Engineers* requires that all noncurrent-carrying metal work shall be earthed. Exemptions are few and include "earth-free situation" and "extra-low voltage circuits" (under 30-v ac, or 50-v dc). Use of 2-pin plugs is specifically discouraged. Normal practice in the U.K. is to use 3-in. plugs and sockets throughout.

The "pigtail" methods of ensuring earth continuity are better than nothing, but not much. They rely on the human element, which is not reliable enough. Failure to earth the connection will not affect operation of equipment, and there is no guarantee it will be used.

The article claims that the parallel-blade 3-pin socket outlet has advantage of admitting 2-pin plugs. But this is unsound. Surely, if we go to the trouble and expense of installing 3-pin sockets, it is folly to allow use of unearthed portable equipment.

The more intelligent course is to use 3-pin outlets that admit only 3-pin plugs, and be sure all portable gear has them. For 3-phase plugs and sockets, select a different pattern so single-phase plug cannot be inserted in a phase socket.

Finally, the earthing resistance. Getting the earthing electrode resistance down low enough may be difficult. But in Whitaker's example of a 120-v circuit protected by a 30-amp fuse, if earthing resistance exceeds 4 ohms, all fuse will do is protect circuit against overloading. It provides no protection against an earth fault—anyone who thinks it does is living in fool's paradise.

If you cannot get your earthing resistance down, then use some form of earth-leakage breaker. British Standard specification states that breaker must trip when the earthed metal is at 25 v above earth. Use the breakers as back-up protection for the fuse. Where necessary, we earth the earth-continuity conductor in the usual way, and, in addition, through the operating coil of the earth leakage breaker, to a separate, auxiliary earth electrode.

As the coil resistance is about 500 ohms, a matter of say 50 ohms electrode resistance in the auxiliary earth will have a negligible effect on operation of the earth leakage breaker. The main earth must still be retained, as it is not safe to rely on the fine operating coil wire for all earthing.

F E M HARDY *Kirkuk, Iraq*

Our Rules Are for the U.S.

WITH REFERENCE TO Hardy's comments, *above*, on the article "How to Ground Portable Electrical Equipment," it seems appropriate to point out that the rules for grounding portable equipment, as defined in *National Electrical Code*, are based on conditions existing in the United States. It would not necessarily follow that they would be the most practical rules for grounding portable equipment in other areas.

It might also be mentioned that the 1953 Edition of the *National Electrical Code*, to be released very soon, will rule out the "pigtail" method of grounding portable equipment.

H B WHITAKER *Chicago, Ill.*

Chrome Cuts Liner Wear

E C COLE'S COMMENTS on diesel cylinder wear (POWER, April, p 138) are interesting. Let me add the following:

Wear of .001 in. per 1000 hr operation seems standard on any good-grade cast-iron liner. But wear can be reduced by plating liners with porous chromium.

Several U.S. power plants report that, with chromium bores, liner wear is only .001 in. per 2000 to 4000 hr, depending on load. One plant in Pennsylvania states that a Baldwin 12¾-in. bore engine, rated at 1000 kw but loaded at 1100 kw, and equipped with chrome-plated liners, wears only .001 in. per 2500 hr operation.

Same benefits apply in marine operations. For instance, the motor vessel *Auricula*, burning 3½% sulfur fuel, achieved 1000 hr (full power) with corresponding wear of .001 in. on a chrome-plated liner. With a cast-iron liner, the wear was .0035 in. per 1000 hr.

I cannot agree with Cole that outlet water temperature of 135 to 140 F is ideal. Important point is to set a temperature sufficient to get beyond the critical point of cylinder condensation. I have seen instances where problem of liner wear by corrosion has been solved by boosting outlet from 140 to 160 F.

W J FRITTON
Van Der Horst Corp of America, Olean, N. Y.

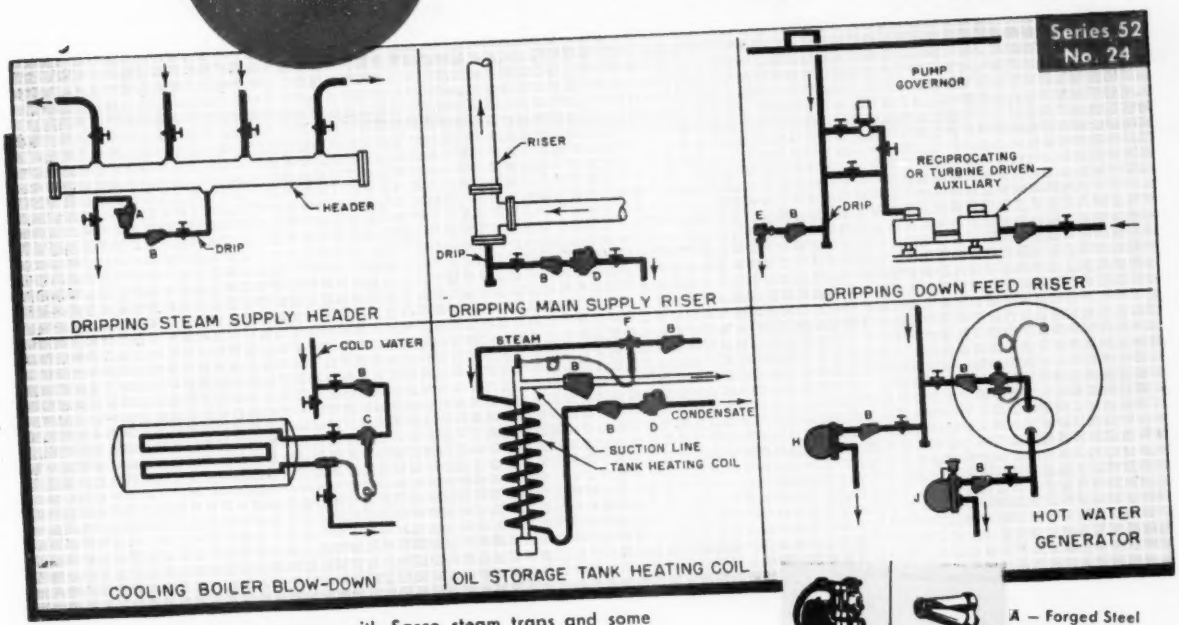
Ignorance Astounds Him

THIS GENERAL IGNORANCE of knibbling pins (July "Arguments") is astounding. When I followed the sea, even our most stupid oiler knew the knibbling pin held the knutter rod.

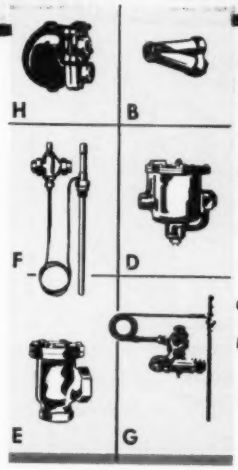
Next thing these ex-mariners will deny ever hearing of the Golden Rivet.

C FOSSLER *Baltimore, Md.*

SARCO in the boiler house...



Assuring dry steam with Sarco steam traps and some Sarco temperature control hook-ups in the boiler house.



A — Forged Steel Bucket Trap
B — Pipe Line Strainer
C — Temperature Regulator, TR-19
D — Inverted Bucket Steam Trap
E — Thermostatic Steam Trap
F — Temperature Regulator TR-21
G — Temperature Regulator 24-30
H — Float-Thermostatic Trap, type FTS
J — Float-Thermostatic Trap, type FTD-M

STEAM TRAPPING AND TEMPERATURE CONTROL problems begin right where steam is generated. The modern boiler plant with its maze of piping and auxiliary equipment offers striking evidence of the advantages of a complete line from one source of supply.

No one type of steam trap or temperature regulator provides the correct solution to all the varied problems presented.

Sarco makes four distinct types of steam traps and can give you unbiased advice on the best type for any job, based on 30 years experience and thousands of installations. ***Write for trap selector chart 145-4.***

The Sarco line of simple temperature control for heating or cooling is complete. ***Full information in Catalog 600-16.***

It pays to standardize on Sarco—exactly the right type of trap or regulator, but all of one make—no divided responsibility!

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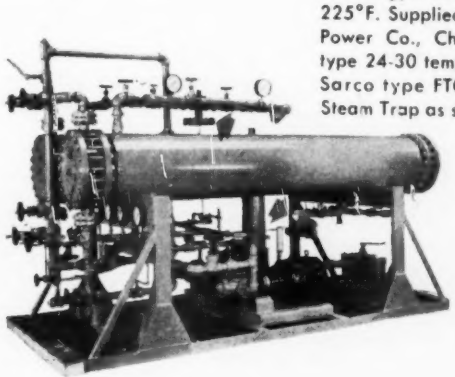
SARCO saves steam
improves product quality and output



Enterprise dual pump set to preheat 3,200 gph of Bunker C fuel oil to 225°F. Supplied by Enterprise Heat & Power Co., Chicago, Ill. with Sarco type 24-30 temperature regulator and Sarco type FTQ Float-Thermostatic Steam Trap as standard equipment.

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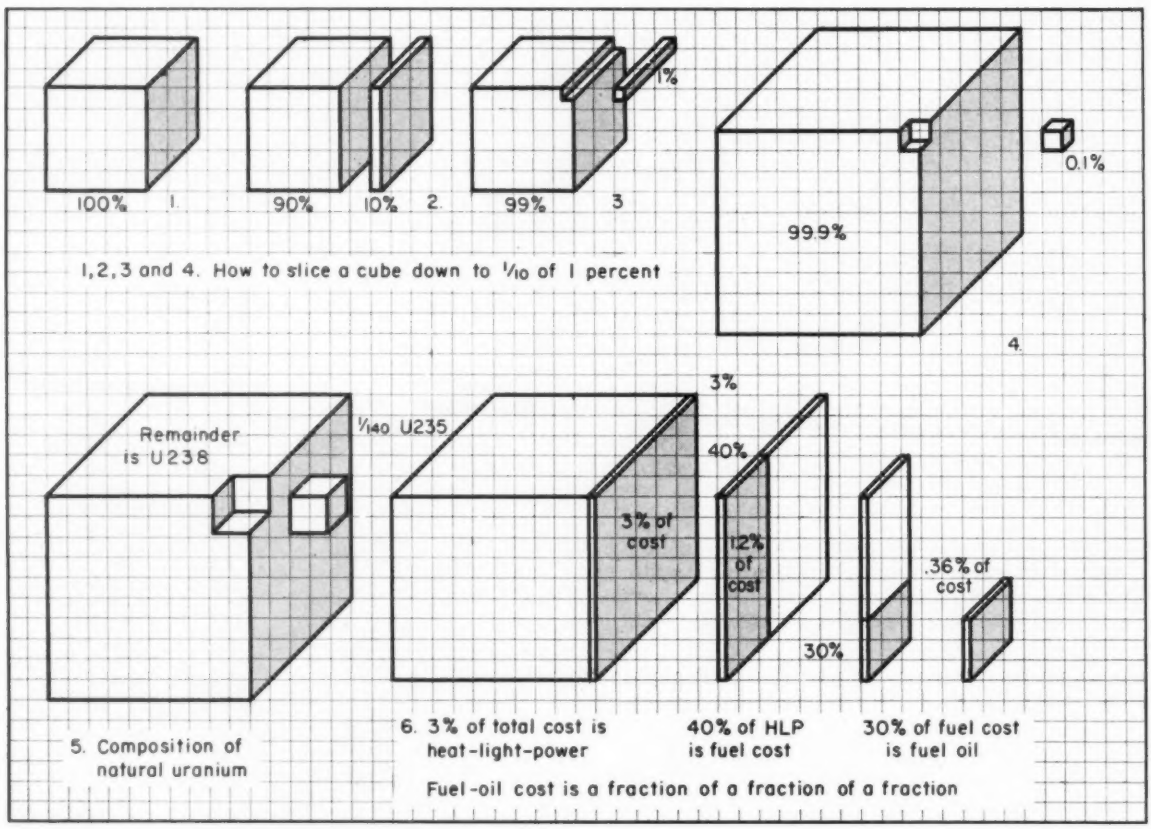
HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Easy Sketching System—13

► HERE ARE some graphical stunts to help you compare something very large with something very small. The trick is to compare by area or volume instead of by length.

Starting point is a cube, Fig. 1. A simple slab, sliced off the end, Fig. 2, gives a clear picture of 10%, say, but this kind of chart won't serve very well for 1%.

One way out is to cut a square-ended rod out of one edge, Fig. 3. The near end of the rod shown is a square one-tenth as wide as the big square. Its area is only 1% of the area of the big square, and the same holds for the volume of the rod compared with the volume of the big cube.

Next, suppose you need to work down to one-tenth of 1%. Here's a hint: If one cube is 10 times as wide as another, its volume is $10 \times 10 \times 10 = 1000$ times as great. Fig. 4 works this backward. Edge of small corner cube is one-tenth as long as edge of big cube, so volume of small cube is only one-thousandth part of the volume of the big cube.

Fig. 5 shows how to picture Uranium 235 as 1/140th part of natural uranium. To get the dimension of the small cube, consult a handbook for the cube root of 140. This is 5.2. Then divide edge of big cube by 5.2 to get edge of small cube.

Fig. 6 shows a stunt I have never seen anywhere in print. It's a smart way to get across an operating figure (here fuel-oil cost) that is a fraction of a fraction of a fraction. Charts like this could have many important uses in business and engineering reports.

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4587

"HOLY SEA COW!" the captain yelled excitedly. "Look! Look below, Chief—"

Marmy's Anvil Chorus

► "ONLY WAY TO GET AROUND a trouble maker is to ignore him," some character was saying when I barged into the Bent Propeller Bar—that fountain of knowledge and emporium of liquid refreshments all rolled into one.

"BILGEWATER ON IGNORING TROUBLE MAKERS!" roared Marmaduke Surfaceblow, the foghorn voice coming to life at his end of the crowded bar. "I'll tell you how I put one foul-ball in his place by giving him plenty of rope."

That did it. Old Marmaduke was at bat again and everyone listened for the usual four-bagger story. The old boy let go his bottle of Sandpaper Gin, rested his back against the bar and blasted away.

"Back in 1942 the port engineer of the Munson Line came aboard the *S S Munorleans* in New York soon as we tied up from a South American trip.

"'Chief,' he began, 'I'm transferring you to the *S S Munargo*.'

"'What's wrong with her Chief, George Mitchell?' I asked.

"'George is getting jumpy as a porpoise,' he answered. 'Captain Westwood keeps sticking his nose into the engine room and sending reports to the line's president. And you know Westwood is the president's son-in-law. So the port captain's afraid to tell him to go soak his head. George Mitchell, on the other hand, is one of those conscientious engineers who takes everything to heart, so I'll have to give him your ship.'

"'Well,' I began, 'I hate to leave this vessel now that I've got her shipshape. I'll take the *Munargo*, but if anyone gets a nervous breakdown, you can bet your sea boots it won't be me.'

"I moved my gear across the dock to the *Munargo* next morning. And George Mitchell took over my berth on the *Munorleans*.

"Captain Westwood sized me up when I signed the articles that afternoon, but he didn't say anything—still, I could see he didn't like the cut of my jib.

"The *Munargo* was a Liberty ship with the usual triple-expansion engine. In New York the assistant engineers made the routine repairs and adjustments that they always make in port when the main engine is shut down. The third assistant had keyed up on the main engine's low-pressure crosshead brasses. But soon as we opened up the throttle on our way to Havana that Sunday, that crosshead started pounding.

"Captain Westwood was in his usual sarcastic mood at breakfast next morning. He greeted me, 'Good morning, Mr. Surfaceblow. Your noisy engine has kept me awake all night.'

"Before I could say anything, he continued. 'To me it sounds like one of your careless men left a wrench or something inside the engine. I suggest you open her up in Havana and remove it.'

"'Left a wrench inside,' I almost echoed. Then I wondered if he was stringing me along. How could anyone who had gone to sea long enough to work up to captain believe that a large wrench could be left in the cylinder without wrecking it. And with only a half-inch clearance between the piston and cylinder, at most. But this was the first time a ship's captain had ever given me advice about my job. I could see why George Mitchell had turned a nervous wreck. And I could see that I'd have to teach this skipper a lesson.

"'That's only one of my headaches right now,' I answered, lifting my safeties before I blew a gasket.

"'What's the other?' he snapped, as if surprised that an engineer would confide in him.

"'It's the ship's anvil,' I said. 'I'll need it in Havana but we can't find it anywhere.' That information didn't impress him and he changed the subject. But at each meal he harped on the engine. The knock did get worse. And his theories about the cause of that knock also got worse. But I didn't say anything—just gave him plenty of rope by agreeing with almost everything he said.

(*Continued on page* 218)

"WHO spilled the N, N'-2 (12-hydroxy-9-octadecenoxylamidoethyl) ethylenediamine?"

LET'S put it this way: WHO SPILLED THE NALCO ANTIFOAM? Either way . . . N, N'-2 (12-hydroxy-9-octadecenoxylamidoethyl) ethylenediamine, or Nalco Antifoam . . . this foam control material is powerfully effective. It is one of several Nalco antifoams that are widely used, not only in boilers, but wherever foaming liquids are a problem.

Nowadays the language of the water treating industry could be full of confusing technical terms . . . like this chemical description of a Nalco antifoam. Translation to common, understandable terms is one of the jobs of your Nalco Representative. You can count on him for an honest appraisal of your problem and a simple, unconfusing recommendation for its solution.

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JENKINS PRACTICAL PIPING LAYOUTS

69

How to plan a

STEAM JET REFRIGERATION SYSTEM

The use of steam for air conditioning has increased steadily during the past few years, principally because of the low cost of steam. In plants generating their own steam, demands on the boiler plant are greatly reduced during the summer months, while plants having to purchase district steam usually benefit by reduced summer rates.

In the steam jet system shown in the accompanying diagram, water is used as the refrigerant. The higher the temperature of the return chilled water, the more efficient the system. Water returned from the chilled water coils of the air conditioning system enters the flash chamber which is maintained at a low pressure by the booster ejector. Here the water is cooled to a temperature corresponding to the boiling point at the reduced pressure. Heat is removed by the flashing of a portion of the returned water to steam which is removed by the ejector.

The booster ejector used in this system requires either a barometric or surface condenser. The latter type is shown here. Pump drives may be either electric or steam turbine, depending upon local operating costs and the size of the installation.

Among the advantages of the steam jet refrigeration system are a high overload capacity and the elimination of moving parts. Air removal equipment and other piping and valving requirements for this system have been described in Jenkins Practical Piping Layout No. 25.

The Jenkins Fig. 106-A Bronze Globe Valves, recommended for various control points in this system, are the Renewable Composition Disc type. They are designed to provide continuous vapor-tight closure, and can be restored to new-like operating condition by simply slipping on a holder containing a new composition disc.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17. Sold through leading Industrial Distributors everywhere.

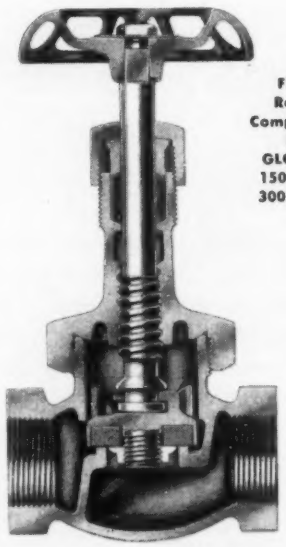
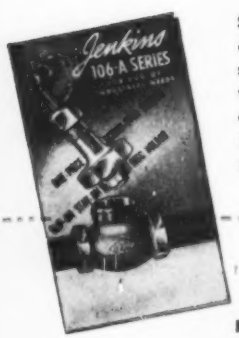


Fig. 106-A
Renewable
Composition Disc
BRONZE
GLOBE VALVE
150 lbs. Steam
300 lbs. O.W.G.



SEND FOR THIS FOLDER. It illustrates and describes the Jenkins Fig. 106-A Valve series, which provides valve combinations for 90% of industrial piping with four bodies and a handful of parts, and tells why Fig. 106-A is industry's favorite for long range economy. Fill out and mail the coupon today.

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STEAM JET REFRIGERATION SYSTEM

Diagram by Huxley Madeheim, Consulting Engineer

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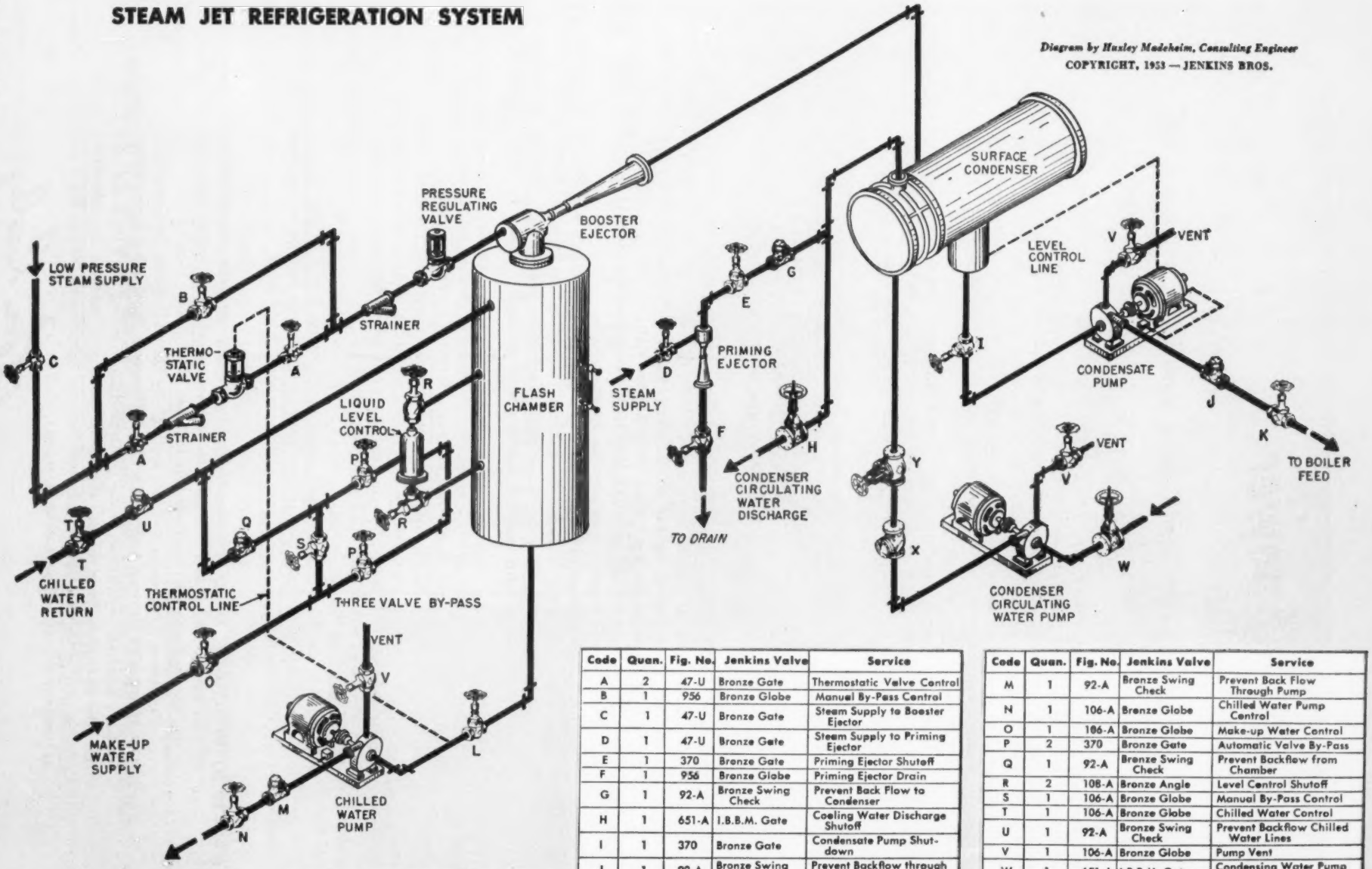


VALVE RECOMMENDATIONS

For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Fig. No.	Jenkins Valve	Service
A	2	47-U	Bronze Gate	Thermostatic Valve Control
B	1	956	Bronze Globe	Manual By-Pass Control
C	1	47-U	Bronze Gate	Steam Supply to Booster Ejector
D	1	47-U	Bronze Gate	Steam Supply to Priming Ejector
E	1	370	Bronze Gate	Priming Ejector Shutoff
F	1	956	Bronze Globe	Priming Ejector Drain
G	1	92-A	Bronze Swing Check	Prevent Back Flow to Condenser
H	1	651-A	I.B.B.M. Gate	Cooling Water Discharge Shutoff
I	1	370	Bronze Gate	Condensate Pump Shut-down
J	1	92-A	Bronze Swing Check	Prevent Backflow through Condensate Pump
K	1	106-A	Bronze Globe	Condensate Pump Control
L	1	370	Bronze Gate	Chilled Water Pump Shutdown

Code	Quan.	Fig. No.	Jenkins Valve	Service
M	1	92-A	Bronze Swing Check	Prevent Back Flow Through Pump
N	1	106-A	Bronze Globe	Chilled Water Pump Control
O	1	106-A	Bronze Globe	Make-up Water Control
P	2	370	Bronze Gate	Automatic Valve By-Pass
Q	1	92-A	Bronze Swing Check	Prevent Backflow from Chamber
R	2	108-A	Bronze Angle	Level Control Shutoff
S	1	106-A	Bronze Globe	Manual By-Pass Control
T	1	106-A	Bronze Globe	Chilled Water Control
U	1	92-A	Bronze Swing Check	Prevent Backflow Chilled Water Lines
V	1	106-A	Bronze Globe	Pump Vent
W	1	651-A	I.B.B.M. Gate	Condensing Water Pump Shutdown
X	1	624	I.B.B.M. Swing Check	Prevent Backflow to Pump
Y	1	613	I.B.B.M. Globe	Pump Control

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

New tenant of this page takes over from Defense Digest just after the Korea truce signing. That's mostly coincidence, though. Reason for the change goes deeper. Truce or no truce, we're still up to our necks in defense business. But we've worked our way out of the "buildup" phase and we've got an administration that doesn't believe in unneeded controls. So, with relatively little to report about bottlenecks, shortages, and regulations to relieve them, Defense Digest seems to have earned honorable retirement.

Of course, when something "hot" comes along we'll run it here, new title for the page notwithstanding. But our aim from now on is to tell you about things that strike us as important, interesting, unusual, or just plain amusing.

Ultrasonic inspection for h-p h-t piping quickly became accepted practice (Power, Oct 1950, pp 102-104). Now it's tackling the new job of locating and measuring corroded areas inside pipelines. It spots trouble areas fine, but before it can be used as a routine method, pipeliners have to find a way to scan pipe surfaces quickly and completely and to "digest" resulting mass of oscillographs.

Bourbon and electricity make a fascinating combination, so you can bet we took more than a casual look at a recent news release tieing up these two forms of energy. Seems that, since Repeal, demand for Old Stagg caused recordbreaking production of 2,000,000 barrels of bourbon at the Albert B Blanton distillery. So the 2,000,000th keg, suitably decorated and inscribed, was tucked away ceremoniously in a little "one-barrel" stone warehouse built for the occasion.

Not content to trust to our interest in whiskey for itself alone, a hardworking ad-agency man coyly captioned the picture "Power Keg" and went on to tell us that more than $900,000 worth of electricity went into making those 2,000,000 barrels. He's probably still lame from reaching for that tieup!

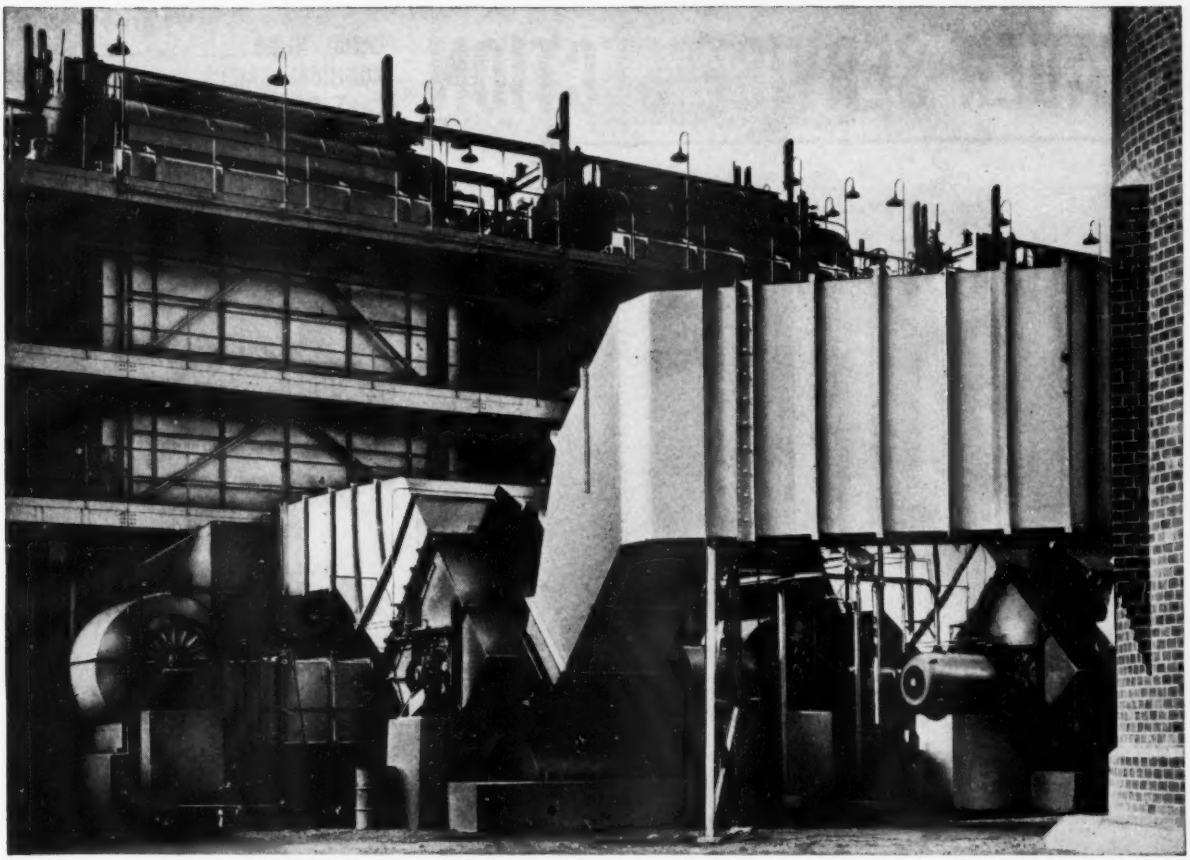
Bagasse burning may well become less common for disposing of pressed sugar cane. It looks as if bagasse may be entering the cycle followed by other waste fuels – sawdust for example. In the old days, sawdust was incinerated. Then, as fuel costs rose, it became worthwhile to burn it as a steam fuel and to develop equipment to do the job efficiently. Now, in many areas fuel use is declining as sawdust finds a place as a raw material for marketable products.

What started this philosophizing was a recent news item about a $2.6 million paper mill in the heart of Louisiana's sugar-cane country. It will be first in U. S. to make newsprint and other papers from bagasse. Test press runs on all-bagasse newsprint have been made by several publishers and it looks good.

Want to write better? Ability to write clearly and concisely can make a big difference to your career. And it isn't too hard to acquire. A number of recent books put across the fundamentals in easy-to-take fashion.

Try these: "Technique of Clear Writing" by Robert Gunning (McGraw-Hill), "Art of Readable Writing" by Rudolph Flesch (Harper & Brothers), "Clear Writing for Easy Reading" by Norman Shidle (McGraw-Hill). Gunning and Flesch not only tell how to improve your writing, they show you how to measure the readability of what you've written. Shidle gives considerable attention to the common forms of business writing – letters, memos, reports, etc.

Lon Lowby



Exposed to the elements—but they withstand freezing, corrosion and dirt.

30 HEAVY-DUTY FANS IN OUTDOOR INSTALLATION AT KAISER ALUMINUM WILL DELIVER 2,875,000 CFM

Mechanical draft equipment at Kaiser Aluminum & Chemical Corporation's Chalmette, La., plant bucks tough working conditions. Installed outdoors, it must combat corrosion, dirt and temperature extremes. Thirty Westinghouse-Sturtevant Fans were chosen to handle all mechanical draft.

Rugged and dependable, 15 Forced Draft and 15 Induced Draft heavy-duty Westinghouse Fans will do the job in any weather. Their heavy, welded steel construction has been built to "take it", and sealed-in bearings resist atmospheric conditions.

The heavy-duty induced draft fans have forwardly curved blades. The heavy-duty forced draft fans have backwardly inclined blades with steep pressure characteristic.

You'll find a Westinghouse Fan to meet your requirements. Expert engineering and years of experience in power generation combine to give you complete satisfaction in mechanical draft. For full information, call your local Westinghouse-Sturtevant office, or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

At full capacity, Kaiser Aluminum's Chalmette plant will produce 400,000,000 pounds of aluminum a year. 375,000 kw of electricity will be steam-generated with oil and natural gas firing, with Westinghouse Fans used for all mechanical draft.

WESTINGHOUSE AIR HANDLING

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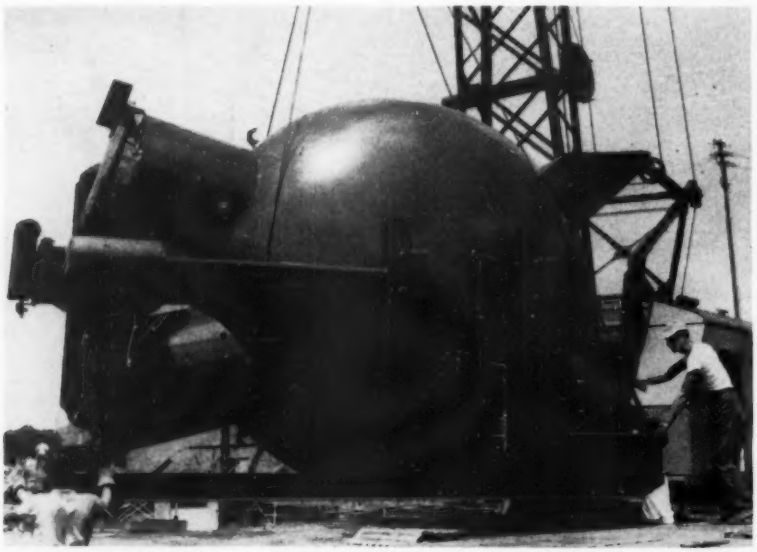


FIRST OF THREE pole units of a General Electric circuit breaker goes to Ohio Power Co's Muskingum River Plant. Unit pictured above is more than 11 feet in diameter and can hold 3350 gallons of insulating oil. The complete circuit breaker, weighing 80 tons, will be a major part of the nation's first 330-kv power transmission network

LARGEST DISCONNECT SWITCH ever built by Westinghouse Electric Corp gets set for test in high-voltage lab. It can handle 330-kv, surge of 1.3 million v

Lack of Funds Ends Gorgas Tests

► UNDERGROUND COAL GASIFICATION experiments have ended at Alabama Power Co's Gorgas mine. Termination of the project resulted from Congressional refusal to allot additional funds for support of the experiment.

Water pumped into the outlet holes extinguished the underground fires on June 20. However, scientific and technical knowledge gained from the four experiments at Gorgas has not been lost and the entire project can be resumed at any time in the future. Similar tests are continuing in Belgium, England and elsewhere.

The Alabama experiment, started in January 1947, was the first development of the underground firing and continuous burning process. Later experiments led to electro-linking, a method of firing the coal by passing an electric current directly through the seam. This process produced high Btu content, synthetic gas in continuous volume and of a purity adequate to operate a gas engine.

Remarkable success of these experiments led to a world underground gasification congress at Gorgas and Birmingham—a meeting that drew noted scientists from many parts of the world. No decision has been made as to possible continuation of the Gorgas project, but the subject is so important that it probably will not be abandoned entirely.

Gas Turbines Boost Venezuelan Oil Output

► GAS TURBINES will soon be pumping gas from oil wells back into field reservoirs to conserve energy and increase ultimate production. General Electric Co has shipped the first two of ten turbines to the Creole Petroleum Corp for the Tia Juana field in Lake Maracaibo.

Fields in Maracaibo, one of the major oil-producing areas of the world, are dotted with flow stations receiving a mixture of gas and oil from wells in the lake. The ten turbines, mounted on 340 x 130-ft platforms seven miles out on the lake, will receive gas piped at

(*Continued on page* 238)

For coming events see page 240

Scotland Plans Peat Fueled Power Project

► AN EXPERIMENTAL PEAT-BURNING power station, to be built at once at Altnabreas, Scotland, forms the first step in an extensive development scheme for the Scottish Highlands.

The pilot plant will consist of a 2000-kw, closed-cycle gas-turbine developed by John Brown & Co, Ltd of Clydebank and a 750-kw, open-cycle turbine manufactured by Ruston & Hornsby of Lincoln. The units will be installed as soon as initial running tests are ended.

The whole pilot scheme will take three to four years for completion and will cost about $1.4-million. A Development Fund, North of Scotland Hydroelectric Board and the British Electric Authority will meet initial capital and development costs. The Hydroelectric Board will handle running costs.

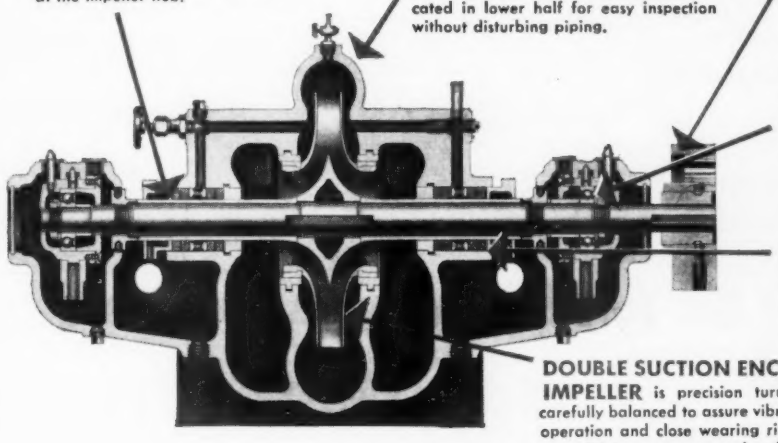
There are about 600-million tons of peat solids, suitable for use as fuel, available in Scotland. If the present project is successful, the Hydroelectric Board plans further developments over the entire area. A gas turbine burning dried peat has run, with very promising results, for 1000 hours at a Clydebank experimental station. The Altnabreas project is a direct result of this success.

Look for These 7 Signs of GOOD PUMP DESIGN

CAST SHAFT SLEEVES, not commercial tubing, save the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.

HEAVY HORIZONTAL SPLIT CAST-IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.

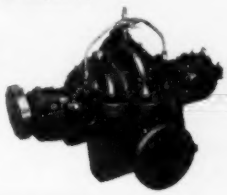
COUPLINGS have *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used. Removal for maintenance is easy.



BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.

GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.

DOUBLE SUCTION ENCLOSED IMPELLER is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance. Water passages are hand finished to a smooth surface.



STANDARD AND SPECIAL MATERIALS are available for many types of service where government regulations permit. Iron, bronze, stainless steel and combinations of these materials handle both alkaline and acid solutions. Standard sizes carried in stock range from 10 to 7000 gpm with heads as high as 475 feet.

THESE DESIGN AND CONSTRUCTION features of Allis-Chalmers double suction pumps assure long pump life and low maintenance costs. Every A-C double suction pump is carefully tested on the most modern pump testing equipment in the industry.

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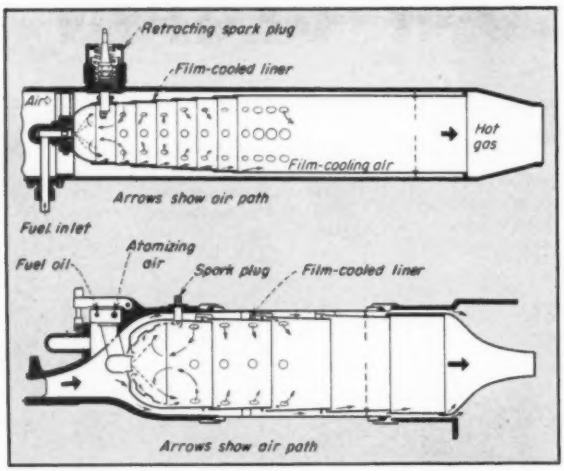
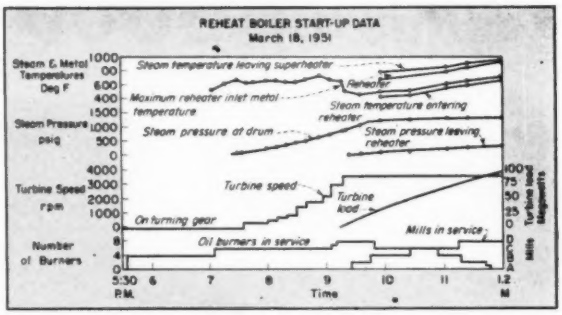




1 Flame can be stabilized by swirl vanes or jet impingement around the tube of gas turbine combustor shown at left

2 Start-up data in graph shown above covers 3-million kw experience on reheat boilers with no special difficulties

Let's Look at Gas Turbine Combustion Problems

Some Practical Aspects of Combustion in the Gas Turbine. *By H R Hazard, Battelle Memorial Institute.*

Burning fuel to produce heat and power has presented problems since man's first use of fire, and every type of engine in use today has its own combustion problems. These may result from special properties of the fuel or its ash or from conditions surrounding combustion and will vary from failure of equipment at one extreme to air pollution at the other. The gas turbine has most of the problems common to other engines plus a few unique problems of its own. Although solution of most of these problems is the responsibility of the development engineer, the operator should have a full understanding of all the factors behind his own operating and maintenance requirements. In this paper some of the practical aspects of combustion in present-day gas turbines are discussed.

The gas turbine differs from other engines in that fuel is burned continuously at high pressures to heat large quantities of air to only moderate temperatures. Heat-release rates are prodigious by boiler standards as small combustion volumes and relatively high pressure losses permit high turbulence levels. Combustors are really direct-fired air heaters in which the air is heated only about 500 to 1000 degrees F, utilizing for combustion less than 20 percent of the available air. Combustion products are mixed with excess air, Fig. 1, to heat entire mass to uniform temperature at turbine inlet.

In several commercial gas turbines, combustor-inlet temperatures range from about 275 F at idling to 500 F at full load, and combustor-outlet temperatures range up to 1475 F. Changes in load are accomplished by changing compressor speed, which has the effect of increasing both air pressure and mass flow in such a relation that the air velocity through the combustors is nearly constant regardless of load. The fuel rate is increased approximately in proportion to the air weight, since fuel/air ratios do not vary greatly over the load range except during acceleration or deceleration. Then a change in fuel rate takes place immediately, but considerable time elapses before the new air rate is established. Combustion pressures vary from 15 psi at idling to about 75 psi at full load in simple units, or may go as high as 120 psi in more complex units.

The two important characteristics of the combustor that affect performance of the gas turbine are combustion efficiency and pressure loss. Low combustion efficiency increases fuel consumption only, but high pressure loss not only increases fuel consumption but reduces power output as well. A change of 1 per cent in pressure loss has approximately the same effect on cycle efficiency as a change of 1.5 per cent in combustion efficiency. The only real limit to heat-release rates in the gas-turbine combustor is the pressure loss required to force the air through the combustor. This increases as the combustor size is reduced. A usual value of pressure loss is about 5 per cent of static pressure (about 20 in. water at atmospheric pressure) with accompanying heat-release rates of 1.5 to 3.5 million Btu per cu ft hr per atmosphere of pressure. *APC Paper, no number.*

Corrosion Aspects of Bunker C Combustion in Gas Turbines. *By B O Buckland and C M Gardiner, General Electric Co.*

The General Electric Company's Gas Turbine Department in Schenectady started testing a Bunker C-burning gas turbine at the factory late in 1947. Since that time, approximately 30,000 hours of Bunker C operation have been accumulated. This operating experience has shown that a basic corrosion problem exists when burning residual oil because slag-forming substances that are present will very likely corrode the metallic parts. A great deal of progress has been made on the solution of this problem, and the work is continuing. The present paper gives the history of operating experience and describes briefly the laboratory and shop tests

(*Continued on page* 150)

Looking for the right packing for your centrifugal pumps?

For shaft speeds to 1750 RPM Johns-Manville Centripac seals better

WEAR on centrifugal pump shafts as well as on oscillating and rotating rods of other equipment is minimized by J-M Centripac. This is because the square cross section of this packing provides the maximum contact surfaces. Thus, it insures a tight seal with the least friction and gland pressure.

Because Centripac is plaited square it retains its shape indefinitely, thus maintaining maximum surface contact for long periods of time. It is made from long-fiber asbestos yarn, thoroughly lubricated and graphited. It seals against fresh or salt, hot or cold water, oil, ammonia, brine, gasoline, and certain weak acids and other chemicals. Because of its wide application, it is a favorite of plant men everywhere.

For general service, Style #7 Centripac is recommended. It contains no wire, is soft enough to conform readily to the packing space, and stands up well in service. It comes in coil form, Style #C-7 and Ring form, Style #R-7. Sizes $^{3}/_{16}$" and up.

For higher shaft speeds, J-M Plastic Packings reduce friction and scoring of shafts and sleeves

Higher centrifugal pump speeds make friction increasingly important in packing and shaft life. That is why J-M Plastic Packings have been designed to have the homogeneous structure and low friction so essential to long packing life in this service.

The exact composition of these packings varies according to the service conditions for which each particular style is designed. As an example, one of these, Style No. 610 is an excellent general maintenance packing for service against steam, air, ammonia, gases, etc. up to 550F. It is made of selected asbestos fiber mixed with pure graphite and a small amount of non-friction metal, then bonded with a heat-resisting compound to form a pliable coil or spiral. It is furnished in sizes of $^{1}/_{8}$" and up.

YOUR J-M PACKING DISTRIBUTOR will gladly recommend the right packing for your equipment, and furnish it from stock for your immediate requirements. Write Johns-Manville, Box 60, New York 16, N. Y. for his name and address. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS and GASKETS

More TECHNICAL BRIEFS

Begins on page 148

The first plant to operate on Bunker C was designed for locomotive use. It was operated on stationary test at the factory in Schenectady and on the test track in Erie for approximately 800 hours, during which more than 250,000 gallons of Bunker C were burned. During factory test and after 492 hours of fired time, the first stage turbine nozzle was oxidized to such a point it required replacement. The nozzle was inspected a number of times during the course of the test, and no oxidation was apparent for the first 390 hours. At the end of the 492-hour period, however, the condition of the nozzle showed definite attack.

Shortly after the failure by corrosion of the first locomotive nozzle during factory test, a program of laboratory investigations was started to learn more about the nature of oil ash corrosion and things which might be done to prevent it. This program has continued from that time forward and is still being actively pursued. Two basic tools which were developed and which are being used in the study are the so-called crucible tests and the small-burner tests. The results of some of the work on crucible tests and the small-burner tests have been reported in a paper presented to the ASME in December 1952. The crucible test measures the rate of corrosion of a small metallic specimen exposed to synthetic oil ashes in a porcelain crucible which is maintained at testing temperature for 20 hours in a well-ventilated air-atmosphere furnace. The small-burner test measures the corrosion effect of actual combustion gases on a small sample.

Over 5,000 such tests have been made to explore the effect of various corroding agents found in typical oil ashes, the resistance of different alloys to these corroding agents, and the effect of a wide range of additive materials which might be considered for use in treating fuel oils. Of all the alloys tested thus far, alloys of iron with a relatively high percentage of chromium are the most resistant to corrosion. The best range of these chromium-iron alloys appears to lie between 27 and 50% chromium, the best of the series being in the neighborhood of 40% chromium. The effect of chromium over the entire range from 27 to 50% is not strongly marked, but below 25% the corrosion resistance decreases sharply as the chromium decreases. Because alloys containing more than 28% chromium at present are difficult to produce, and because alloys containing less than 25% are poor in corrosion resistance, we have done most of our testing and research work on a 28% chrome-alloy and are now using this material in many of the first-stage nozzles. The straight 28% chromes are too weak at high temperatures to be satisfactory for many applications, but there is evidence that modified alloys of this type can be made which will be stronger and still have good corrosion resistance. It is not expected that they will be strong enough for highly stressed parts such as buckets. They will have sufficient corrosion resistance to give satisfactory operating life with many untreated fuels.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., Mar 24-27, 1953. Identified by initials APC and obtainable in proceedings printed and distributed by R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill. $6.00.

American Society of Mechanical Engineers, spring meeting, Deschler-Wallick Hotel, Columbus, Ohio, April 28-30, 1953. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

It has, therefore, been concluded that in addition to using the best alloys at hand, some method is also needed to treat gas turbine fuels—either to remove the corrosive agents or to introduce additives which react with the corrosive ash constituents and render them harmless. Data obtained from the crucible tests to date indicate that vanadium pentoxide and sodium sulfate are the two most corrosive agents found in appreciable quantities in any of the oil ashes we have examined, so much of our work has been directed toward finding methods of reducing corrosion by these two materials. For inhibiting corrosion by vanadium pentoxide, compounds of calcium, magnesium, strontium, barium or nickel all appear to be good. Some of these have been suggested by previous investigators in this field. The fact that nickel serves as an inhibitor for vanadium corrosion is probably consistent with the fact that we have found practically all high-nickel alloys to be poor in resistance to vanadium corrosion. It may be postulated that the vanadium has a high affinity for nickel so that when the latter is introduced as an additive it ties up with vanadium and prevents further corrosion; whereas, when it is present in any alloy exposed to vanadium, in certain temperature ranges at least, the nickel is attacked.

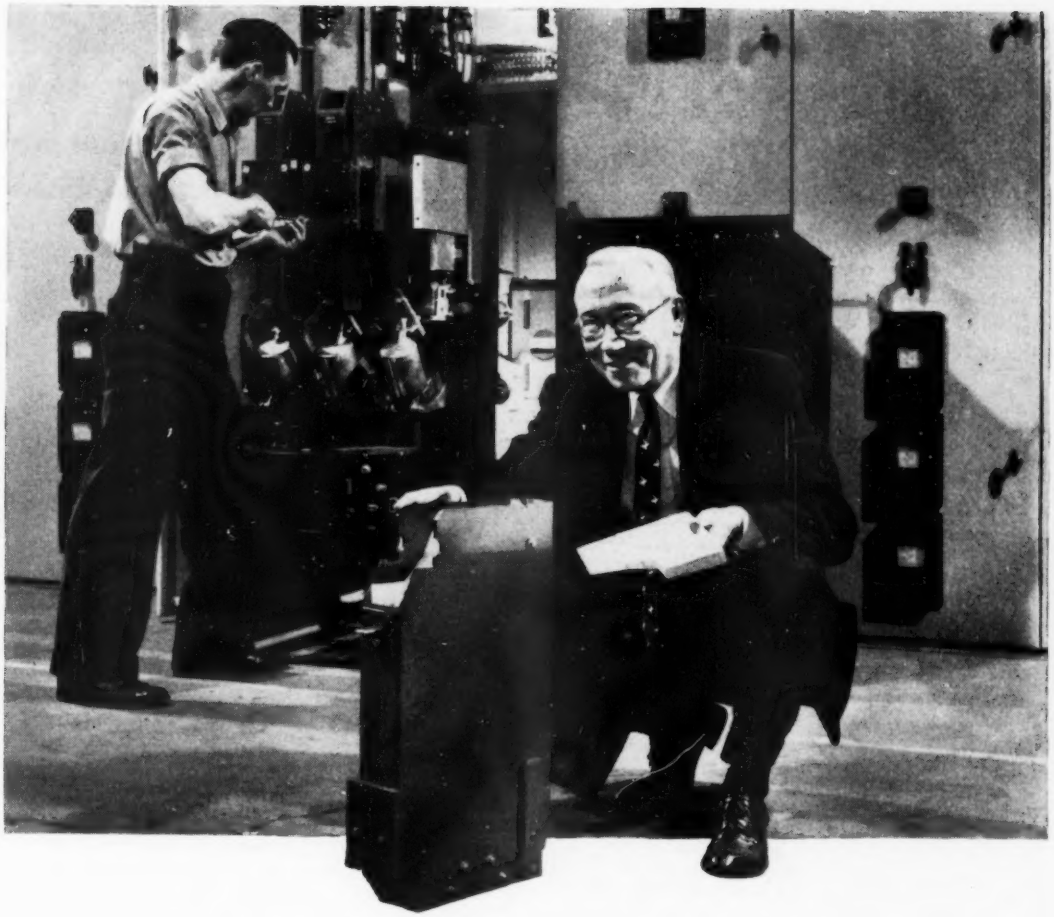
It has also been found that sodium sulfate and vanadium pentoxide to some extent inhibit one another, and a sodium containing oil relatively free from vanadium will have a more corrosive ash than one containing the same amount of sodium and approximately three times as much by weight of vanadium as sodium. In every case when a suitable amount of a calcium compound is added to a mixture of vanadium pentoxide and sodium sulphate in which the weight of sodium present is less than 0.3 that of the vanadium, a very low weight loss is obtained. Curves, given in paper, show the percentage weight loss of the crucible specimen, plotted on a parabolic scale, versus the ratio of vanadium pentoxide to the sum of the weights of the sodium sulphate plus the vanadium pentoxide, on a linear scale. The simplified synthetic ash represented by the abscissa covers a range in composition from pure sodium sulphate on the zero end to pure vanadium pentoxide on the 100% end of the scale. As can be seen, the minimum corrosion rate occurs in the high vanadium oxide half of the ash scale when calcium is added to the mixture. Results such as these are the basis of a fuel specification proposed in August 1951, the essential features of which are given in Table I. *APC Paper, no number.*

Fuels and Firing

3,000,000 kw Operating Experience with Modern Reheat. *By Otto de Lorenzi, Combustion Engineering, Inc.*

Between January 1, 1946 and January 1, 1953 a total of 221 units having a total rated electrical capability of 27,582,000 kw, in sizes ranging from 40,000 to 250,000 kw, were on order, under construction, or in operation. Of this number 105 units, totaling 14,475,000 kw, were ordered between March 1, 1951, and January 1, 1953. The summary given by the author, in addition to showing size distribution of these units, also provides throttle pressures and primary steam temperatures.

(*Continued on page* 222)



How we combat corrosion and searing arcs

In most industrial plants, metal-clad switchgear is under constant attack—inside and out. To protect against the effects of arcing, Westinghouse lines arc chutes with a true ceramic containing a high percentage of *zircon,* which has the highest melting point of any known material.

Additional important factors in chute life that maintenance men appreciate: Westinghouse chutes will not absorb moisture, have dielectric properties comparable to porcelain.

This switchgear employs the most effective method of arc extinction in use today. The arc is extinguished in split seconds and it is on the main contacts for only a fraction of this time. Result: less contact burning, less chute wear, less shock to the whole unit.

Bonderizing® best practical surface protection

The best practical metal surface protection that we know of for switchgear is Bonderizing. We Bonderize our metal enclosures *after* they're assembled so that every nook and cranny gets the full five-dip treatment. Then the enclosures are painted twice and the paint sticks as though it is part of the metal.

In Westinghouse outdoor switchgear there's no worry about corrosion on the undersurfaces, either. After assembly, we spray them with a heavy layer of rubberized coating.

When you're planning switchgear installations, call in Westinghouse. And write now for your copy of booklet B-5306. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

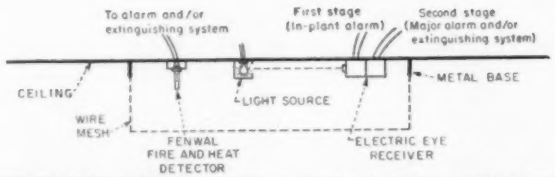
J-60820-C

YOU CAN BE SURE...IF IT'S Westinghouse

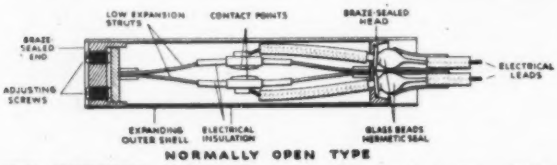
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



SCHEMATIC DIAGRAM shows separate actuating mechanisms for the system's independent smoke and heat detection circuits



FIRE DETECTOR is hermetically sealed against dirt. Outer shell expands on temperature rise, closing switch contacts

Smoke and Fire Detector

904 • New fire-protection unit has a two-stage smoke detector plus an independent fire or overheat detector.

The smoke-detecting unit consists of a light source and an electric-eye receiver. It operates when receiver detects a drop in light intensity, showing the presence of smoke. Depending on the amount of light absorbed, the receiver triggers one of its two stages. The first stage, responding to a relatively low smoke density, usually sets off a local plant alarm. Second stage operates at higher smoke density, sets off a major alarm or extinguishing system.

The separate fire detector unit responds to heat. Known as a *Detect-A-Fire*, made by Fenwal, Inc, it operates on an entirely independent circuit to an alarm or extinguishing system, providing response if a relatively smokeless fire occurs. This detector uses differential expansion of metals to produce an effect known as "rate compensation." Detector is said to function consistently at its pre-set operating temperature regardless of the rate of rise in temperature of the surrounding medium. It operates when surrounding temperature reaches a point that can be set anywhere from 140 to 725 F according to degree of protection desired.

Cardox Corp, 305 N Michigan Ave, Chicago 1, Ill.

Radiation Detector

903 • Pocket-size *Gamatek* indicates on a direct-reading scale the total dosage of Gamma and X-rays to which a body or area has been subjected, manufacturer states. By observing time needle takes to move across the scale and referring to a table printed on the back, instrument can be used as a radiation rate-meter. It is designed for monitoring in atomic research, medical and industrial radiology, etc. Bulletin CEC-1008.

Consolidated Engineering Corp, 300 N Sierra Madre Villa, Pasadena 15, Calif.

Safety Switch

950 • New 200-amp front-operated safety switch for 250 and 600 v lines has visible blades. Oversize handle shows up distinctly from a distance, indicating whether switch is on or off.

Fuse holder has pressure spring under the fuse where it is said to be unaffected by fuse heat. The two joints to each pole are under heavy pressure from external steel springs. Contact resistance is said to be minimized, preventing heating. Insulated cross bar underneath the switch blades assures opening of the switch when handle is thrown to "off" position.

Federal Electric Products Co, 50 Paris St, Newark 5, N. J.

(Continued on page 154)

Pressure Relief Valves

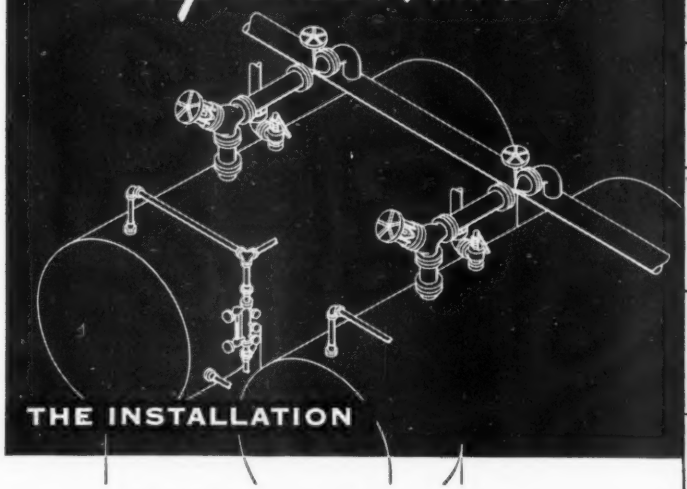
922 • New larger-sized pressure relief valves for hot water space heating boilers protect against over pressure. The new valves, shown in the photograph at left, are called the 1-inch No. 230 and the 1½-inch No. 230. They are suitable for use on boilers with heat output to 743,400 Btu/hr and 1,025,100 Btu/hr, respectively; they open at 30 psi.

Operating parts are of non-corrosive materials, and valves are said to be tamper-proof.

McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago 18, Ill.

For more data on these items, use post cards p. 161. Identify your request with item number.

30 Years of Safety and Efficiency with these High Quality Stop-Check Valves



At the Eureka Redwood Lumber Company, Eureka, Calif., featuring eight 5-in. Crane stop-check valves on boiler lines to main steam header.

VALVE SERVICE RATINGS

SUITABILITY:	On the job for 30 years
FEATURES:	Only one moving part
MAINTENANCE COST:	One seat regrinding only
SERVICE LIFE:	Installed 1923 – still O.K.
OPERATING RESULTS:	Efficient performance — safe operation
AVAILABILITY:	Crane Catalog item – No. 30E

THE CASE HISTORY

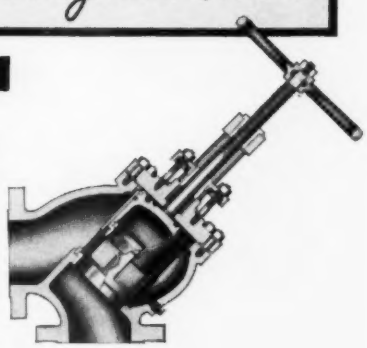
Thirty years' continuous service is by no means the record for Crane 250-Pound stop-check valves. But when 6 such valves, all installed in 1923, are still on the job, and still giving complete satisfaction, surely that's worthy of note. So well did these Crane No. 30E stop-checks perform right from the start, that 11 years later, in 1934, 2 more were put on boilers installed that year.

Here are 8 valves with a collective service record of more than 220 years. And in all that time, the only maintenance required was regrinding the seat of one valve.

It takes a lot of quality to deliver such valve performance with so little upkeep. That's why today, in face of rising maintenance cost, Crane quality is more than ever the first choice of the thrifty valve buyer.

THE VALVE

Simplicity and dependability are still the chief characteristics of Crane 250-Pound stop-check valves. They have just one moving part—the piston-type disc that operates in a removable liner, without chatter, vibration, or rapid wear. You'll have a safer power plant with these valves on your boilers, and they'll permit steam flow to the main header at minimum pressure drop. See your Crane Catalog or Crane Representative for complete information.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

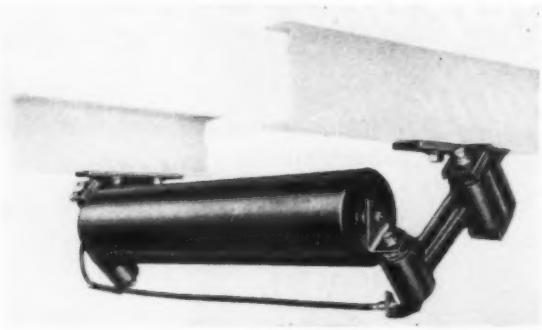
CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 152



Belt-Training Idler

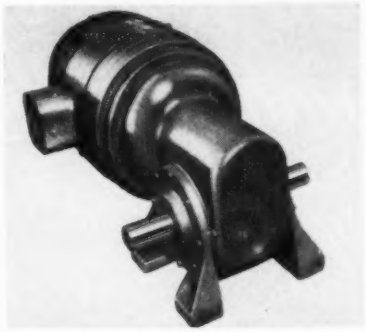
937 • Rex style No. 41 roller-bearing belt training return idler is said to provide automatic alignment for the return belt without the use of side guide idlers. Unit consists of a dead-shaft roller-bearing return roll, mounted at each end to a toggle-like arrangement of swivel arms suspended from the conveyor framework at a 45-degree angle in the direction of belt travel.

Lateral movement of the belt to one side results in increased weight on that side. This causes that end of the roll to move forward and downward. At the same time opposite end of the roll moves backward and upward, and belt is guided back to the central position.

Idler acts to maintain equilibrium, with belt in center and roll in normal position. Action is said to be equally effective on horizontal, inclined or declined conveyors. Idler operates in one direction only.

Available in standard 5- or 6-in. diameter steel return rolls. Also available in standard 5½-in. diameter rubber-covered spiral return roll. Further details may be obtained from manufacturer.

Chain Belt Co, Milwaukee 1, Wis.

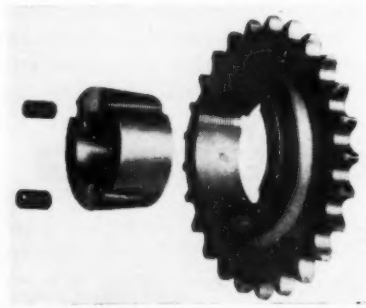


Motor Speed Reducer

912 • Right-angle worm gear *Motoreducer* is available in ½, ¾, 1 and 1½ hp ratings with speeds as low as 18, 24, 36 and 58 rpm respectively. Unit is suitable for floor, ceiling, side or wall mounting. It will permit simultaneous use of as many as 3 output shafts from the same motor when desired, one from the motor shaft and either one or two low-speed takeoffs from the reducer.

Rueland Electric Co, Alhambra, Calif.

For more data on these items, use post cards p. 161. Identify your request with item number.

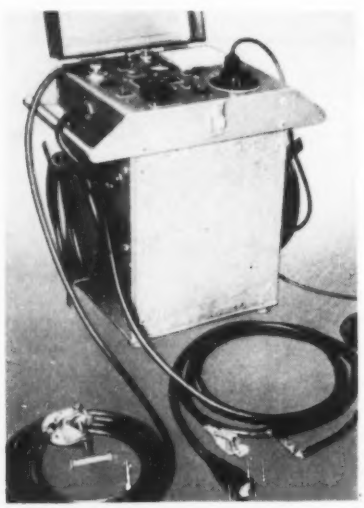


Roller Chain Sprockets

940 • New line of roller chain sprocket wheels has taper-lock bushings to facilitate rapid installation and assure tight fit within normal range of shafting tolerances. Set screws force and hold split tapered bushing in tapered bore of the sprocket wheel.

These sprockets are available for ½, ⅝, ¾, 1 and 1¼ in. pitch single-width chains. Booklet No. 2449.

Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.



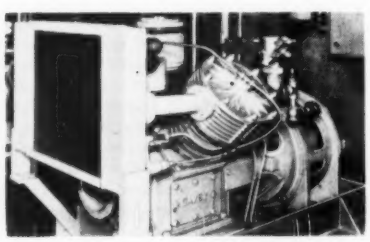
Cable Fault Locator

924 • Model 4 transmitter and dc proof tester is designed for use on lead-covered cable installed in ducts, can also be used on aerial and buried cable. Maximum output is 15 kv dc, discharge capacitance is 2 muf.

Unit weighs 150 lb, requires a source of supply of about 600 va at 115 v ac. It can be used as a source of dc voltage for proof testing cable and other insulation at installation or after alterations or repairs. Manufacturer states that maximum proof testing capacity is 15 milliamps at about .7 megohms and 50 milliamps at short circuit.

Transmitter can be supplied with or without the model 2 detector, which is standard equipment for locating faults by the impulse method. Bulletin 65-24.

James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.



Air Compressor

952 • Model 25D stationary air compressor has a displacement of 128 cfm. It is direct-connected to a 25-hp electric motor, and is available with constant speed or start-and-stop pushbutton controls as desired.

Compressor is of V-type design with one 7⅜ in. low pressure cylinder and a 4⅜ in. high pressure cylinder. Stroke is 4½ in.

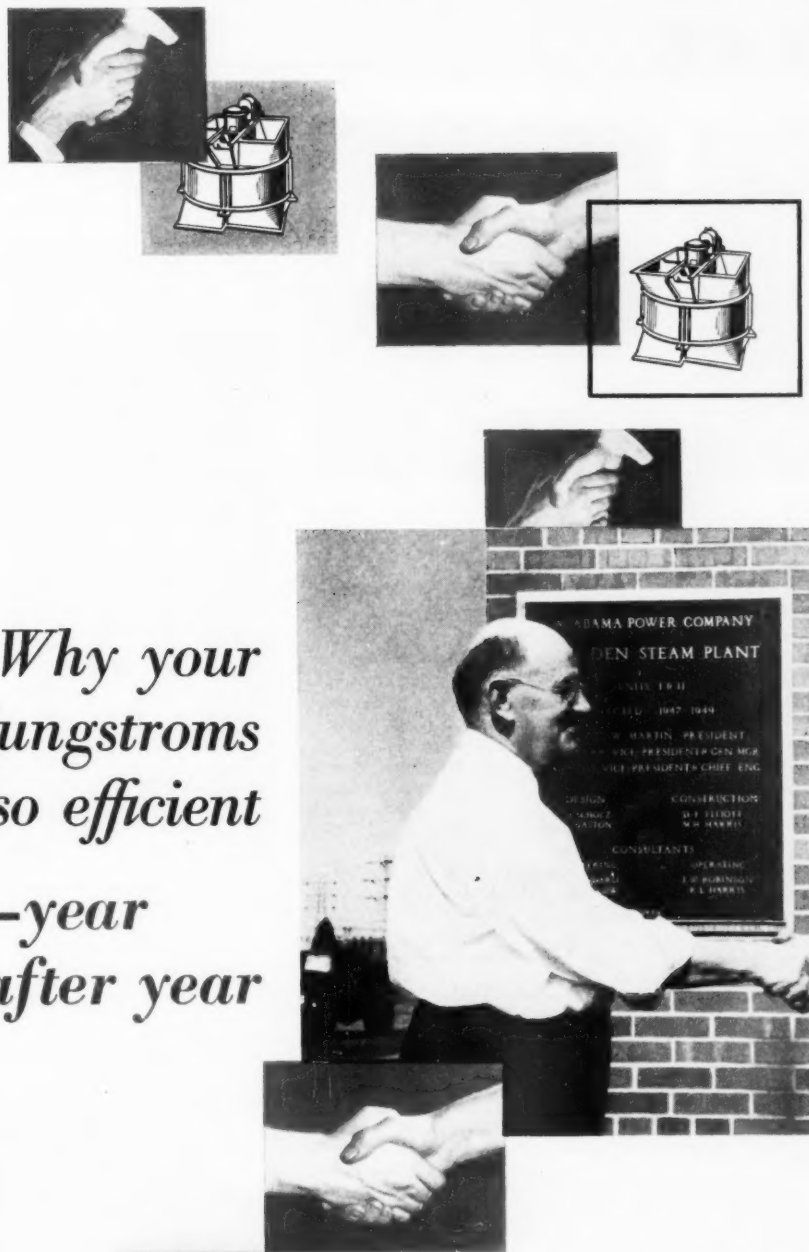
Davey Compressor Co, Kent, Ohio

Liquid Level Controls

951 • Tank controls operate in this way: two stationary electrodes are suspended in the tank where a circuit between them is established or broken by rising or falling liquid level. This circuit actuates relay that operates solenoid valve installed in either supply or discharge line. Components are available in several sizes, can be used with all types of liquids.

Johnson Corp, Three Rivers, Mich.

(*Continued on page 156*)



Why your Ljungstroms are so efficient

—year after year

Air Preheater Corporation Field Engineers aim to visit every Ljungstrom Air Preheater in this country at least once a year. Their main objective is to increase availability and assure you a maximum return on your investment. They are always available for consultation.

This is just another reason why the Ljungstrom Air Preheater is *the most economical heating surface on the modern boiler.*

THE AIR PREHEATER CORPORATION

60 East 42nd Street
New York 17, N. Y.

More EQUIPMENT NEWS

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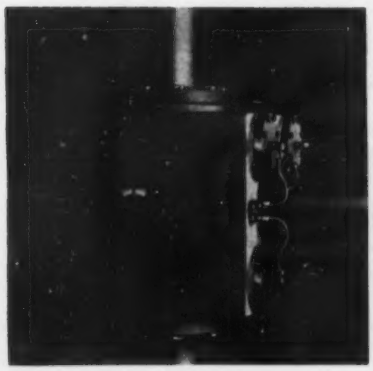
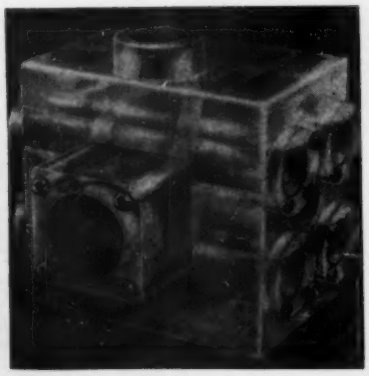


CAST IRON valve construction is suitable for the non-corrosive applications



PLASTIC valve for corrosive service is made of inert material throughout

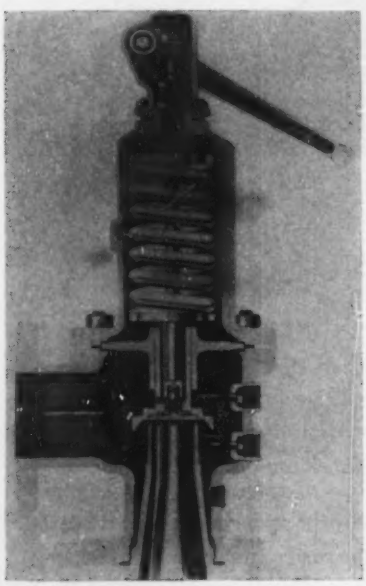
Four-Position Cycle-Controlling Valve

920 • *Cycloflow* valve is a four-position single control valve said to provide a simple means for controlling the flow through ion exchange equipment. The four positions permitted are backwash, regenerant introduction and displacement, rinse and service.

Unit is essentially an assembly of hydraulically-actuated, single-seated poppet valves constructed in balanced pairs. Each valve component assembly includes two poppet valves and two operating pistons joined by a connecting rod.

For non-corrosive applications like sodium zeolite softening or dealkalization by chloride anion exchange the valve body is made of cast iron, available in 2½, 4 and 6-in. pipe sizes. These valves can be operated up to 250 F and 100 psig. For corrosive applications like demineralizers, hydrogen cycle exchangers, plating or waste units, the valve is made from an inert plastic—Plexiglas, Lucite or Uscolite. Available in 1½, 2½ and 4 in. pipe sizes for service up to 100 psig, 180 F. Valves can be adapted to automatic, semi-automatic or manual operation with no alteration or additional field adjustment.

American Water Softener Co, Inc, Fourth and Lehigh Ave, Philadelphia 33, Pa.



Safety Relief Valve Has Internal Heat Exchanger

946 • Internal heat exchanger eliminates necessity of steam tracing or steam jacketing a nozzle or semi-nozzle safety relief valve where highly viscous lading is encountered. The heat exchanger keeps the lading material in a fluid state with exceptionally low steam consumption, manufacturer states.

Exchanger consists of a steel coil inserted into the valve body and led out to connect with a steam line. The coil ends are accessible for return-pipe installation or one-pipe installation with a vent valve. A steam trap drains the coils, and construction is said to be suitable for back pressure.

Farris Engineering Corp, 627 Commerial Ave, Palisades Park, N. J.

Bonding Agent

954 • Available in rod, powder, paste and liquid form, new bonding agent, *ChemoTec,* is claimed especially formulated for joining metals to similar or dissimilar metals, or to non-metallic materials such as ceramic, glass or wood. Applied at 250 to 300 F, agent has high wetability and thin flowing characteristics that give best bond in joint clearances of from .004 to .008 in.

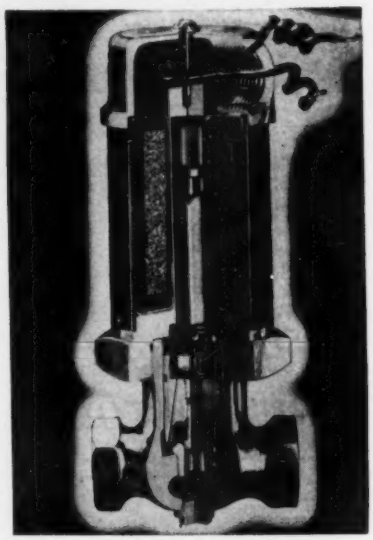
ChemoTec Div, 172nd St & Northern Blvd, Flushing, New York, N. Y.

For more data on these items, use post cards p. 161. Identify your request with item number.

Plastic Valves

953 • Corrosion-resistant plastic globe and "Y" valves are said to withstand action of most acids and a variety of caustic solutions. They are recommended for service up to 50 psi, 150 F, and available in ½ to 2 in. sizes. Literature available.

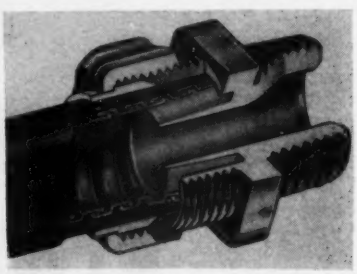
Vanton Pump Corp, Empire State Bldg, New York, N. Y.



Steam Valve

925 • Improved design steam valve is said to prevent sticking. Manufacturer claims new valve automatically compensates for normal expansion and deposits, providing greater efficiency, longer life, lower maintenance.

Atkomatic Valve Co, Dept 200, 545 Abbott St, Indianapolis 25, Ind.



Liquid Tight Fitting

955 • Fitting for liquid-tight flexible conduit mates with any conduit spiral and doesn't have to be taken apart when installed, according to manufacturer. It is especially useful for electrical circuits exposed to corrosive liquids and mineral oils. Made in straight, 90-degree and 45-degree elbows, for conduit from ⅜ to 2 in. trade size.

Manufacturer states that only one wrench size is needed for gland and body. Color coded plastic seal in the gland indicates size.

Thomas & Betts Co, Elizabeth, N. J.

(*Continued on page* 158)

For Condenser Plates and Tubes... it's REVERE

Condenser plate for large steam power plant, ready to ship from a Revere mill.

In 1808 Paul Revere rolled the copper plates for the boilers of Robert Fulton's second and third steamships. Ever since then Revere has been a preferred source of supply for rolled non-ferrous plates. Today you will find Revere plates in marine and stationary condensers, heat exchangers, evaporators, feed water heaters and similar equipment in ships, chemical plants and refineries, public and private generating stations—wherever long service is essential.

Revere plates, like Revere condenser tubes, are available in all the customary alloys, shapes and sizes. For collaboration in selection of the most durable alloy, consult Revere.

And write on your company letterhead for a free copy of a most informative booklet: "Life Extension for Condenser Tubes."

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

More EQUIPMENT NEWS

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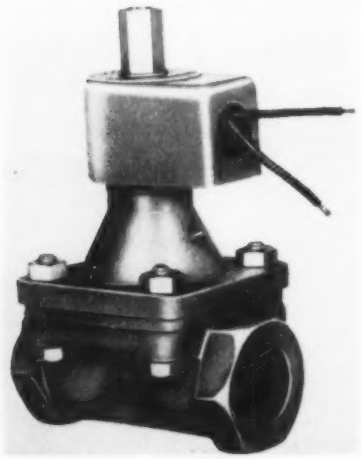
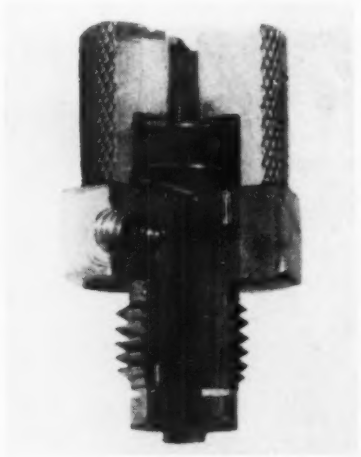


Pilot-Controlled Valve

956 • Valve uses Saunder's patent type valve body, handles highly corrosive liquids and gases. Manufacturer claims that absolutely tight shut-off is provided.

Pressure (air or liquid) is introduced directly from the pilot and impressed on diaphragm to close valve. Upon release of the imposed pressure, line pressure opens the valve. Pipe sizes range from ½ to 2 in. Standard unit is satisfactory for pressures up to 125 psi, class H high temperature coil permits pressures up to 150 psi.

Automatic Switch Co, Orange, N.J.



Bleeder Valve

933 • Semi-automatic *Greer-Lane* bleeder valve for hydraulic and pneumatic lines of any size or pressure is semi-automatic, spring-loaded rotary type using a channeled, knife-edge cap that uncovers the bleed port with a twist of the external head. Spring closes valve when head is released, and bleed-port cap knife-edge shears off and cleans out any entrainment caught at the bleed opening, manufacturer states. Internal O-ring prevents leakage around shaft.

Greer Hydraulics, Inc, 454 18th St, Brooklyn 15, N. Y.

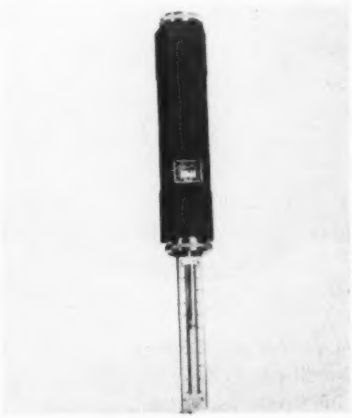
For more data on these items, use post cards p. 161. Identify your request with item number.

Gravity Feeder

915 • *Liquifeeder* gravity-type liquid feeding device is said to maintain a constant rate of feed, and is adjusted by a valve that meters air admitted to the supply tank.

Feed can be varied from less than ½ pint to more than 500 gallons per day. Unit can be constructed of material to suit the fluid used. Manufacturer recommends its use in treating water in cooling tower systems.

Hankison Corp, 269 Biltmore Bldg, 951 Banksville Rd, Pittsburgh 16, Pa.



Flow Meters

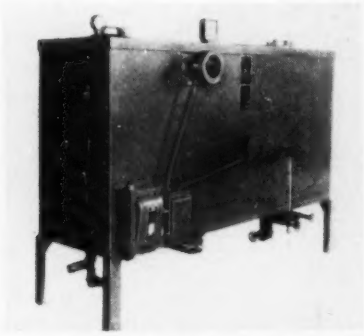
957 • Available in 11 sizes for air and industrial gases, each meter has its own built-in calibration for specific gas and flow rate to be measured. Oil in glass tube dampens pulsations, makes measurement reading easy.

Units are available for dissociated ammonia, propane, exothermic cracked (rich and lean), air, natural gas, hydrogen, oxygen, nitrogen, etc. Bulletin 201.

Waukee Engrg Co, 759 North Milwaukee St, Milwaukee 2, Wis.

CHECK THESE TOO!...

Portable Indicators	p 168
Electronic Relay	p 172
Explosion-Proof Switch	p 176
Turbine Pump Motors	p 180
Submersible Sump Pump	p 184
Filter Pumps	p 188
Boiler Burner Unit	p 192
Feed Water Deaerator	p 194

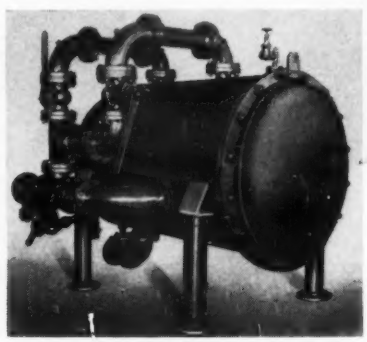


Water-Oil Separator

944 • *Dri-Pure* water-oil separator is said to be specially effective in removing moisture from vacuum pump oils, can also be used for turbines, hydraulic systems and similar operations where water creates an oil contamination problem.

Unit features two filtering compartments using cellulose fibre and fullers earth filtering media, plus a thermostatically controlled heating and settling tank. Filter cartridges are replaceable. Heater unit can be connected to any convenient electrical outlet. Bulletin available.

Honan-Crane Corp, 200 Superior Ave, Lebanon, Ind.



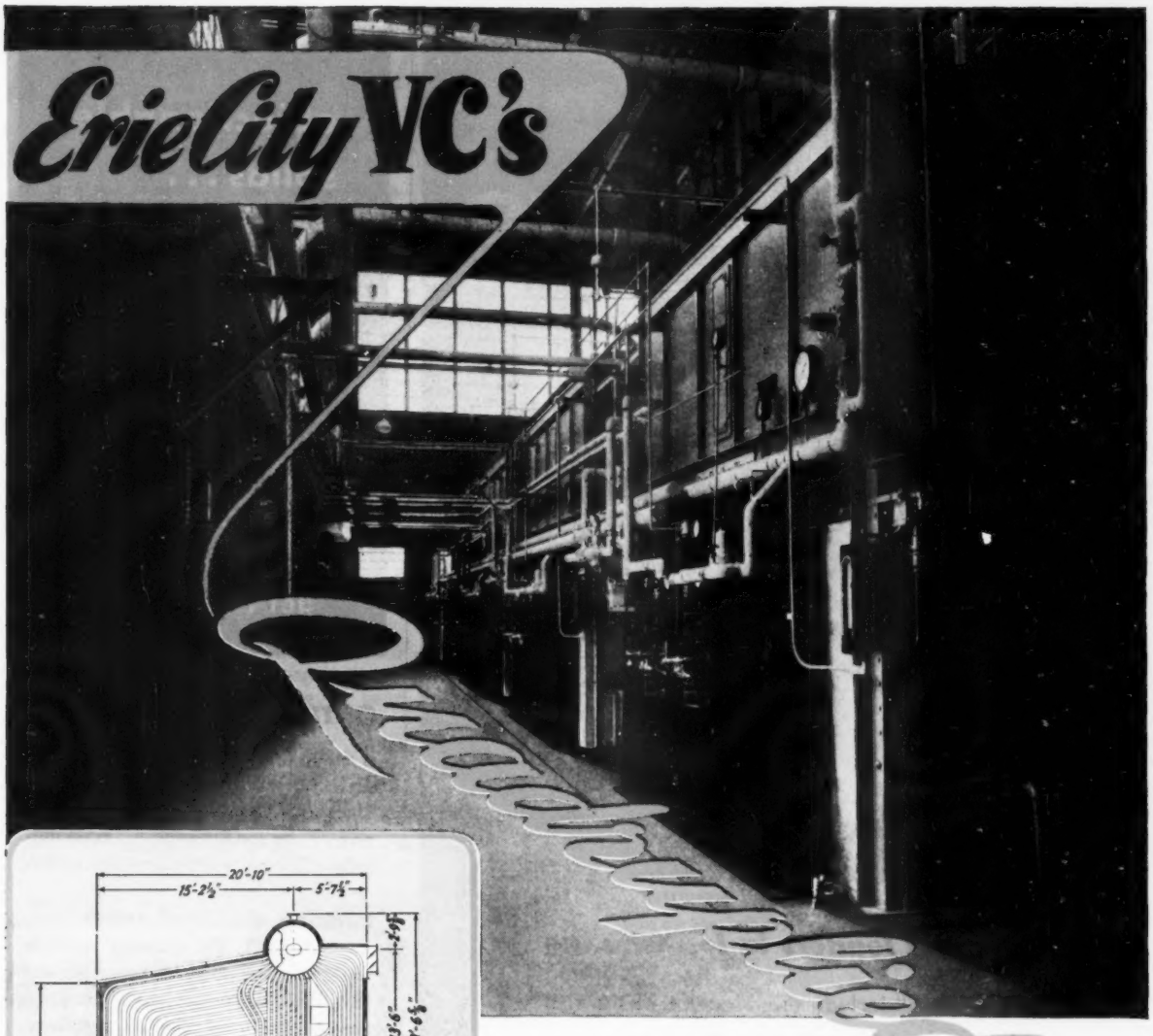
Water Filter

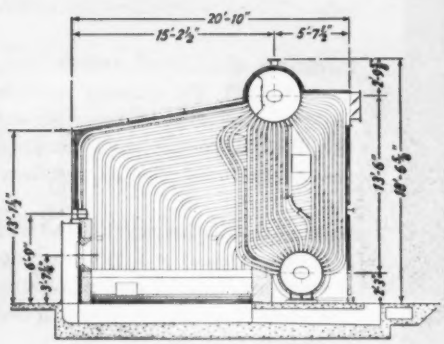
919 • New diatomite filter unit can be used for large volume water filtering, manufacturer states. Sparkler model SCJ filter is said to remove either colloidal or solid suspended matter, and up to 80 to 100% of bacteria. Unit allows use of raw water sources for industrial plant water supply.

Available in sizes from 25 to 1000 sq ft of filtering surface. Flow capacities over 2½ mgd per unit.

Sparkler Mfg Co, Mundelein, Ill.

(*Continued on page* 168)





BOILER DATA

Boilers (4)	Type 4 VC-28-30
Capacity each	33,000 lb/hr
Design Pressure	300 p.s.i.
T T Steam	366 F
Fuel	Oil

FOR FLEXIBLE OPERATION

These four identical VC units may suggest a similar solution to your steam modernization program. With furnace sides, front and top water cooled, these compact 2-drum water tube boilers concentrate maximum steam producing capacity in minimum cubage.

Multiple units permit operating at peak efficiency over a wide variation of loads. Investigate multiple units in your steam modernization program. Economize with a multiple installation of medium size . . . standardized units available for any method of firing.

Ask for **BULLETIN VC-9**

You can depend on Erie City for sound engineering

ERIE CITY
112 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

ILLCO-WAY ionXchange

serving the essential power plants of American industry

pioneers and leaders in ionXchange

ILLCO-WAY "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . and the development and building of the first successful installations for the purification of such liquids as beet-juice and crude glycerol by ionXchange . . . In the power field, boiler feed water treatment by ILLCO-WAY ionXchange has long meant lower operating costs and increased operating efficiency. Installations in leading plants.

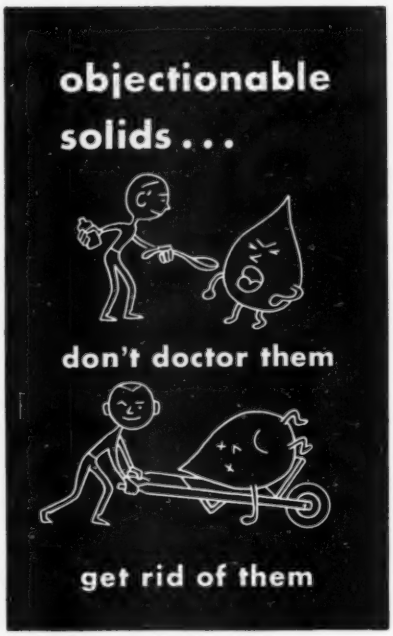
ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

For complete data, see Sweet's File, Power Plant

ILLINOIS WATER TREATMENT CO., 853-9 Cedar St., Rockford, Illinois
141 East 44th Street, New York 17, N.Y.
Canadian Distributor: Pumps & Softeners Limited, London, Canada

(Advertisement)



OUTSIDE the boiler

is the logical place to treat feedwater! An ILLCO-WAY De-ionizer removes objectionable solids the logical modern way . . . by ionXchange . . . economically . . . *before* water enters the boiler.

Remove dissolved solids ILLCO-WAY De-ionizers provide water free of dissolved solids, silica and CO_2. Manual or automatic controls; flow rates to meet plant requirements.

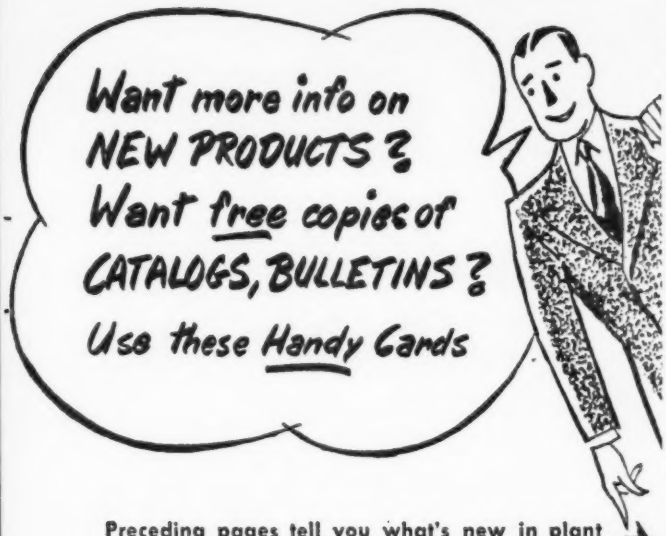
Remove hardness ILLCO-WAY Softeners (manual or fully automatic) provide any required amount of zero-soft water. Compact, economical, easy to operate.

Remove alkalinity ILLCO-WAY Hydrogen Zeolite units reduce alkalinity, soften plant supply. Water with controlled alkalinity and zero hardness to meet requirements.

Send for your free copy...

of Boiler Feed Water bulletin "Treatment X," containing performance data, installation views. Please write on company letterhead. Address: Illinois Water Treatment Co., 853-9 Cedar Street, Rockford, Illinois.

ILLCO-WAY



Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

Want quick direct-from-manufacturer service?

USE THESE CARDS

- First check what you need: more information on a new product or an ad, copies of free catalogs, bulletins
- Then describe the product, or literature desired. Give model numbers, bulletin numbers wherever you can
- Be sure to write in number of page on which item appeared, and issue of POWER in which you spotted it
- Finally, address reverse side of card to the manufacturer concerned

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This month's FREE Literature

AIR CONDITIONING

1 **Dehumidification** problems treated in 4-page leaflet. Presents photos, price lists and table of recommended humidities for home and industry. Bulletin 374, Abbeon Supply Co, 179-15 Jamaica Ave, Jamaica, N. Y.

2 **Air handling** units for industrial, commercial air conditioning discussed in 6-page booklet. Covers constructon, installation, operation of complete line of units and accessories. Bulletin 1600, Westinghouse Sturtevant Div, Dept T-071, 200 Readville St, Boston 36, Mass.

3 **Refrigeration controls** covered in 4-page, illustrated leaflet. Describes application, operation, special features of recording, indicating and non-indicating instruments in low temperature range. Bulletin 109, Partlow Corp, New Hartford, N. Y.

BOILERS & AUXILIARIES

4 **Purifiers,** scrubbers, mist extractors, separators, etc described in 4-page folder. Photos, exploded views and selection tables for Type ID Hi-eF purifiers. Bulletin 401, V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio

5 **Steam generators** and allied equipment discussed in 20-page, 2-color catalog. Presents photos, drawings, specs for boilers, heat recovery units, process equipment. Catalog GB-153, Union Iron Works, Erie, Pa.

6 **Zero-oxygen deaerators** described in 8-page, 3-color booklet. Covers fundamental deaerating principles and advantages of Schaub line. Photos, cutaways, specs. Bulletin 575, Fred H Schaub Engrg Co, 2110 S Marshall Blvd, Chicago 23, Ill.

7 **Packaged automatic boilers** for light oil, heavy oil, gas or combination gas-oil firing discussed in 15-page, 3-color booklet. Photos, graphs, cutaways and full specs. Bulletin 1219, Orr & Sembower, Inc, Reading, Pa.

8 **Water tube steam** generators presented in 8-page, 2-color booklet. Data, specs for completely assembled units in 9 sizes ranging from 5300 to 33,000 lbs steam per hour and pressures up to 400 psi. Photos, sketches, cutaways. Superior Combustion Industries, Inc, Dept W, 1475 Broadway, New York 36, N. Y.

9 **Jet tray deaerator** described in 4-page illustrated leaflet. Shows combined advantages of spray-type, direct-contact, first-stage heater (Type K-114) performing as direct contact vent condenser and primary deaerating mechanism. Bulletin 28R7980, Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

10 **Package boilers** ranging from 4000 to 30,000 lbs per hr presented in 16-page catalog. Photos, operational sketches, space requirement tables, specs for type VP boilers. Combustion Engrg, Inc, 200 Madison Ave, New York, N. Y.

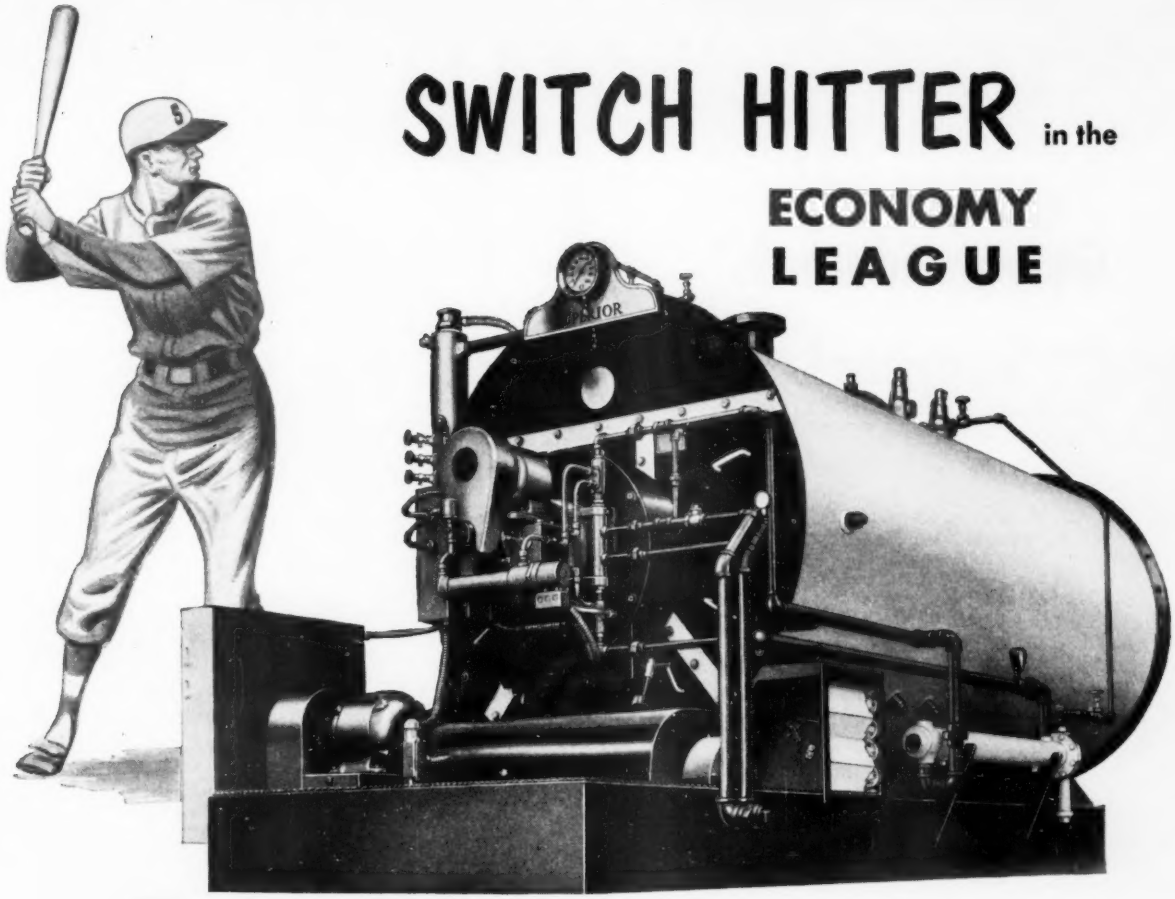
COMPRESSORS & ACCESSORIES

11 **Air-cooled, industrial compressors** from 10 to 100 hp, 55 to 540 cfm displacement covered in 8-page, 2-color booklet. Photos and spec tables. Davey Compressor Co, Kent, Ohio.

12 **Non-lubricated compressors** from 25 to 600 hp, 172 to 8800 cfm described in 8-page, 2-color booklet. Photos, section drawings, full specs of the WGO-9 heavy duty, vertical compressor. Joy Mfg Co, Henry W Oliver Bldg, Pittsburgh 22, Pa.

13 **Air hose** and its various industrial uses discussed in 4-page bulletin. Sectional and cutaway photos, performance data, specs. Also includes types of couplings for specific hoses. Quaker Rubber Corp, Div of H K Porter Co, Inc, Pittsburgh 24, Pa.

(Continued on page 244)



SWITCH HITTER in the ECONOMY LEAGUE

SUPERIOR
STEAM GENERATORS

Just as the switch hitter changes his batting stance to take full advantage of the pitching situation, Superior Steam Generators change fuels to take advantage of the price situation. When equipped with combination gas/oil burners, Superior Steam Generators switch from one fuel to the other quickly, and without dismantling the equipment or interrupting the steam supply.

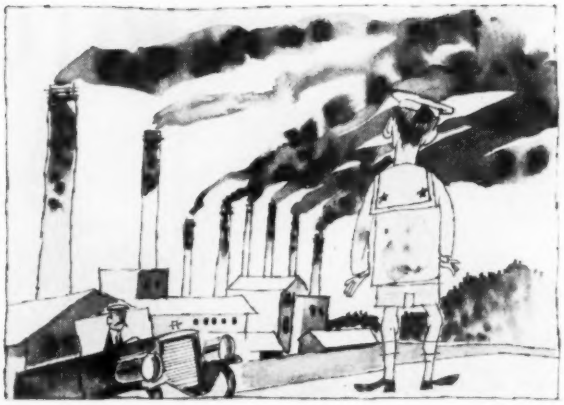
Superior Steam Generators are completely factory-assembled and fully tested prior to shipment for guaranteed performance exceeding 80% thermal efficiency, fully automatic . . . burning oil or gas . . . and are available in 18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for catalog 500-F.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook



Our local power company put in electrostatic precipitators last month to keep our town from being showered with flyash. Back in my kid days factory owners prided themselves on the amount of **smoke their stacks belched** into the sky. I'm told dust particles often reached several million to the cubic foot.

Makes me think of the ancient Greeks amusing their friends by rubbing silk with amber to create static electricity so the amber would attract straw. That was over 2000 years ago, but we finally put the idea to practical use. Who said human beings aren't on their toes?

* * *

"To insure success, pick the right boss and proceed to make his life easy"—PHIL SWAIN, from his New Proverbs For Young Engineers.

* * *

I see where J E Chapman of Duke Power Co built **a portable power plant.** He uses it to prevent costly shutdowns when changing or replacing conductors, transformers, and other line and sub-station equipment. Total weight is 25,000 lb. It's a standard Fruehauf trailer with a war surplus P-51 (air plane) liquid-cooled (Glycol) Allison engine, of 1150 hp. Rating is 500 kw, 80% power factor. Complete unit cost $22,000, has been used 15 times in past three years.

Last time I was in New York, seems Ben Skrotski on POWER *suggested that public utilities build large mobile units. His idea was to have them on hand to supply power at any trouble spots in an enemy attack on this country. Wonder what happened to that scheme?*

* * *

America has furnished to the world the **character of Washington,** and if our American institutions had done nothing else, that alone would have entitled them to the respect of mankind. —DANIEL WEBSTER

A compressor manufacturer I know has been building what he calls a "new kind of centrifugal pump" for the past few years. Said his staff has been so busy making the thing work right they haven't had time **to do much research.**

I told him to write the Office of Technical Service, Dept of Commerce, Washington 25, D.C. They stockpile about 250,000 technical reports that have never been published in scientific or technical journals. "Those government people are not only glad to send you anything they have on pumps," I told him, "but they are even glad to give you technical advice."

My motto has always been to know what others have done before I go stubbing my toe in the dark.

* * *

An **enlightened mind** is not hoodwinked; it is not shut up in gloomy prison till it thinks the walls of its own dungeon the limits of the universe, and the reach of its own chain the outer verge of intelligence.

—HENRY WADSWORTH LONGFELLOW

* * *

It's just a hundred years since Elisha Graves Otis demonstrated his **"safe" elevator** at the Crystal Palace Exhibition in New York City by cutting the lift rope of an elevator loaded with freight and one assistant. Spectators were amazed to see that brakes gripped the elevator guides and kept the loaded platform from plunging into the basement.

Before that time, four to six floors were tops in buildings. Realtors along Broadway looked at their vacant upper floors, wondering what they could do to cash in on that floor space.

Just proves that most problems can be licked with the right approach. In this case it was safety.

George Edwards
Engineer

BOILER CLEANED CLEANER BY DOWELL SERVICE

Chemical solvents removed 1650 lb. of deposits from boiler previously "cleaned" by turbining

When you consider that liquid chemical solvents will reach wherever water will flow, you can soon appreciate the many advantages of cleaning with chemistry.

Where mechanical devices, rattling, and turbining fail to clean—in crevices, around angles, through openings—Dowell solvents are designed to dissolve and loosen scale and sludge . . . carry away these profit-stealing deposits quickly and easily.

For example, Dowell recently cleaned a 150,000 pphr boiler that had previously been turbine-cleaned. Although the chemical cleaning required only a few hours, Dowell engineers removed 1,650 *additional* pounds of deposits from the boiler. Best of all, no scaffolding or dismantling of equipment was necessary. Dowell-designed equipment was used to introduce special liquid solvents through regular connections. Downtime was kept to a minimum.

What is *your* cleaning problem? Dowell has extensive experience in cleaning all kinds of process and heat exchange equipment. Dowell furnishes trained personnel, pump trucks, and control equipment.

Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing.

For further details or estimates, call your nearest Dowell office or station. Or write to Tulsa, Dept. I-23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

OPERATOR CHECKS READINGS OF HAYS ELECTRONIC OXYGEN METER WHEN BURNING MULTIPLE FUELS

THESE INNOVATIONS IN BOILER PLANT INSTRUMENTATION ARE MAKING NEWS

New instruments meet demands of outdoor boilers, space saving, greater speed of response, multiple fuel firing

Boiler plant instrumentation is changing.

Electrically operated combustion control is being used more and more as larger numbers of outdoor boilers are installed. For all-weather operation electric combustion control is preferred since electricity doesn't freeze, is readily available, doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

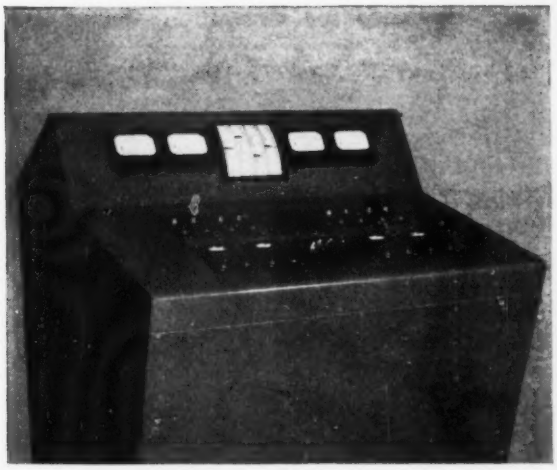
More miniature indicators and control stations mounted on console or graphic panels are appearing as operators demand more instruments in less space. All essential information is concentrated for fingertip control while supplementary indications and recordings are located on adjacent standard size panels.

Electronic instruments are becoming more numerous because they give faster speed of response and greater accuracy, can be placed anywhere, eliminate pressure lines into the panel.

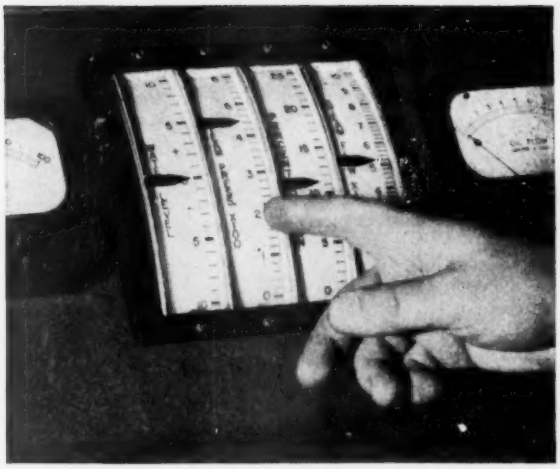
Oxygen recorders have become standard equipment where fuel flexibility is desired. Unlike other combustion guides, oxygen measurement is unaffected by the varying Hydrogen-Carbon ratios of different fuels, hence gives the *only* accurate check where more than one fuel is being burned.

In response to these trends The Hays Corporation offers the complete, modern boiler plant instrumentation line including electric combustion control; highly visible, internally illuminated Miniscales; custom-made panels; new electronic mercury-less flow meters; new 1, 2 and 3 element electronic feedwater control; combustion guide instruments of every type including the Magno-Therm electronic oxygen recorder.

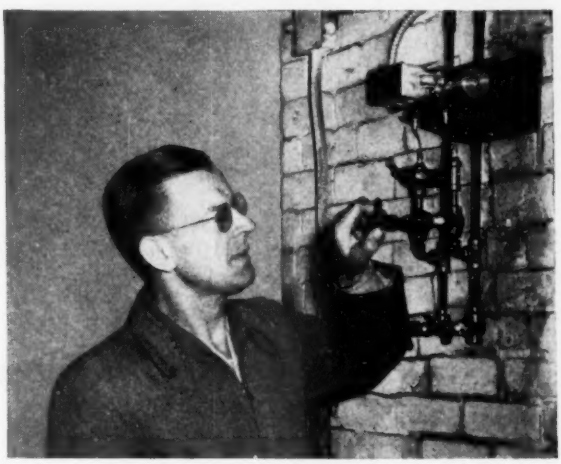
Write for free bulletins on any of these products—available from The Hays Corporation, Michigan City, Ind.



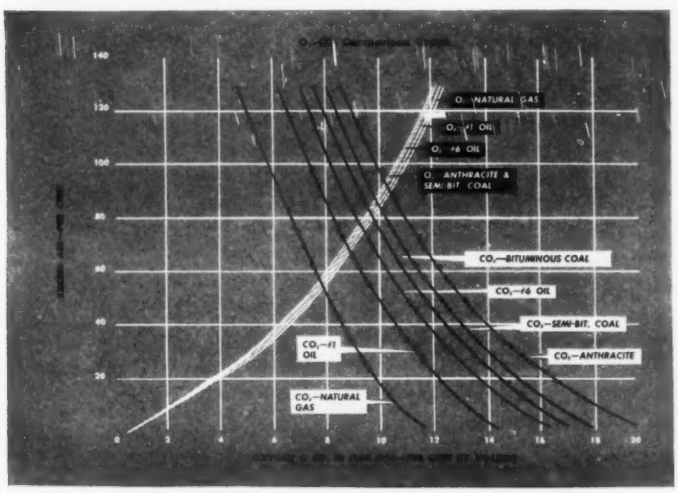
MORE INSTRUMENTS IN LESS SPACE has been accomplished with Hays Miniscales on a console panel. Miniscales indicate any variable. Transmission is either electrical or pneumatic on highly visible, internally illuminated 5" scales. Hays console panels are custom-made to conform to individual specifications.



OUTDOOR BOILERS, which eliminate the need for expensive enclosures, demand all-weather dependability from controls. Hays all-electric combustion control doesn't freeze, eliminates expensive dryers and compressors.



ELECTRONIC INSTRUMENTS have greater speed of response and accuracy. Here operator inspects transmitter of new Hays electronic mercury-less flow meter. Recorder can be located at remote distances from transmitter.



IN BURNING MULTIPLE FUELS only O_2 gives an undistorted picture of excess air present in flue gas — as demonstrated by this graph.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY, 3, INDIANA

an ACCO product

Why You Can Expect Longer, Trouble-Free Service

• The choice of metals used in the R-P&C Rising Stem Bronze Gate has a lot to do with its fine service record. The body is cast of high test bronze in our own foundry, the stem is high tensile rolled bronze, while the solid wedge and seat rings are nickel-alloy.

The design is important, too. The union bonnet adds strength and won't distort the valve body or threads when it is removed. Fluids don't come directly in contact with the operating threads and the rising stem shows position of the wedge. It's easy to disassemble this valve where frequent cleaning is necessary.

The **No. 716** R-P&C Bronze Gate Valve is made in sizes ¼" to 3", for 200 lbs. steam pressure at 500° F; or 400 lbs. OWG, non-shock. It is economical to buy and use.

• See your R-P&C distributor or write our Reading, Pa., office for literature

ACCO

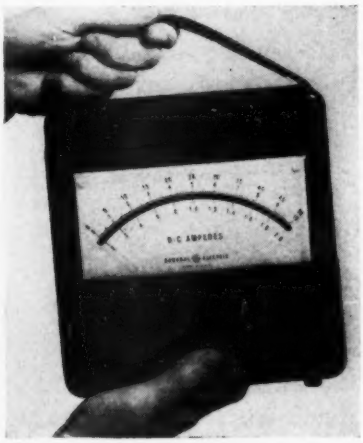
R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

More EQUIPMENT NEWS

Begins on page 152



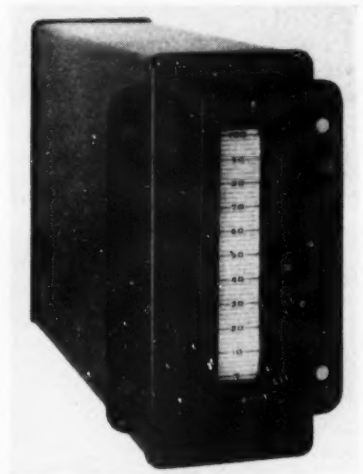
Portable Indicators

936 • New portable instruments, type DP-11 and DP-12 are available to indicate volts, watts, amps and milliamps. DP-11 is designed for general testing for electrical maintenance men, has accuracy of 0.5% of full scale. DP-12 is accurate to 0.25% of full scale, is particularly suited to maintenance of portable or switchboard instruments, control panels, etc.

Instruments measure 7¾x7⅞x3¼ in., weigh 5 lb.

General Electric Co, Schenectady 5, N. Y.

For more data on these items, use post cards p 161. Identify your request with item number.



Indicating Receiver

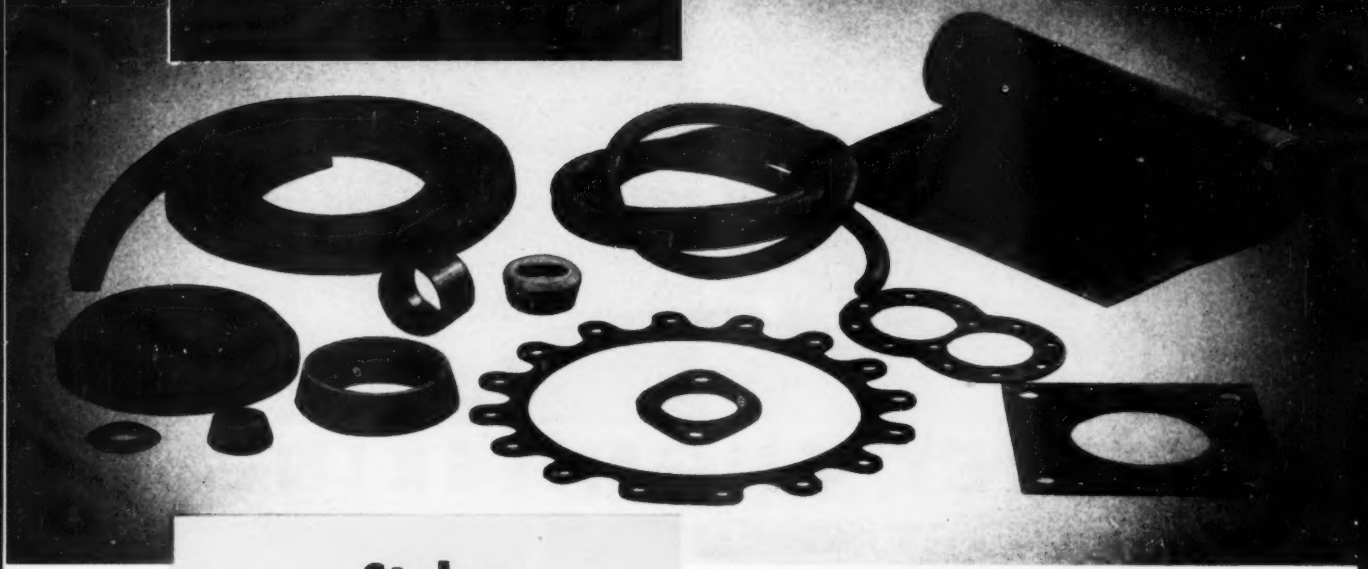
945 • Model 50 *Consotrol* indicator is especially suited to panel applications that require continuous indication of valve position or variables like liquid level, manufacturer states. Instrument is available with single or dual indicating scales and can be adjusted for direct or reverse response to measurement. Scale measures ¾x4¼ in. Alarm contacts are optional.

Foxboro Co, Foxboro, Mass.

(*Continued on page* 172)

ANKOPRENE*

...Is Highly Resistant to Oil, Gasoline and Solvents!



Styles

9952 • 9975 • 9986

Ankoprene synthetic rubber material is truly remarkable for difficult jobs. It is not a substitute for rubber, but is widely adapted to a variety of applications. The field of application is unlimited. Used on difficult jobs such as chemical equipment, autoclaves and oil lines. Furnished in the form of bushings, diaphragms, diaphragm sheet, fabric reinforced sheet, gaskets, grommets, molded parts, packings, sheets, slab, sponge, sponge tubing, washers.

*Our trade name indicates one of our many compounds the base of which is Neoprene, designating a plastic polymer of chloroprene as manufactured by E. I. duPont deNemours & Company.

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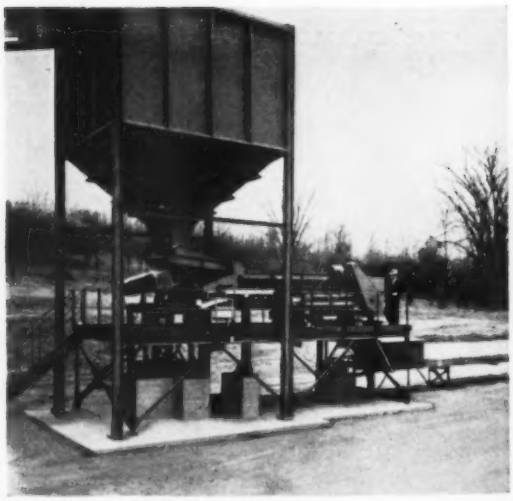
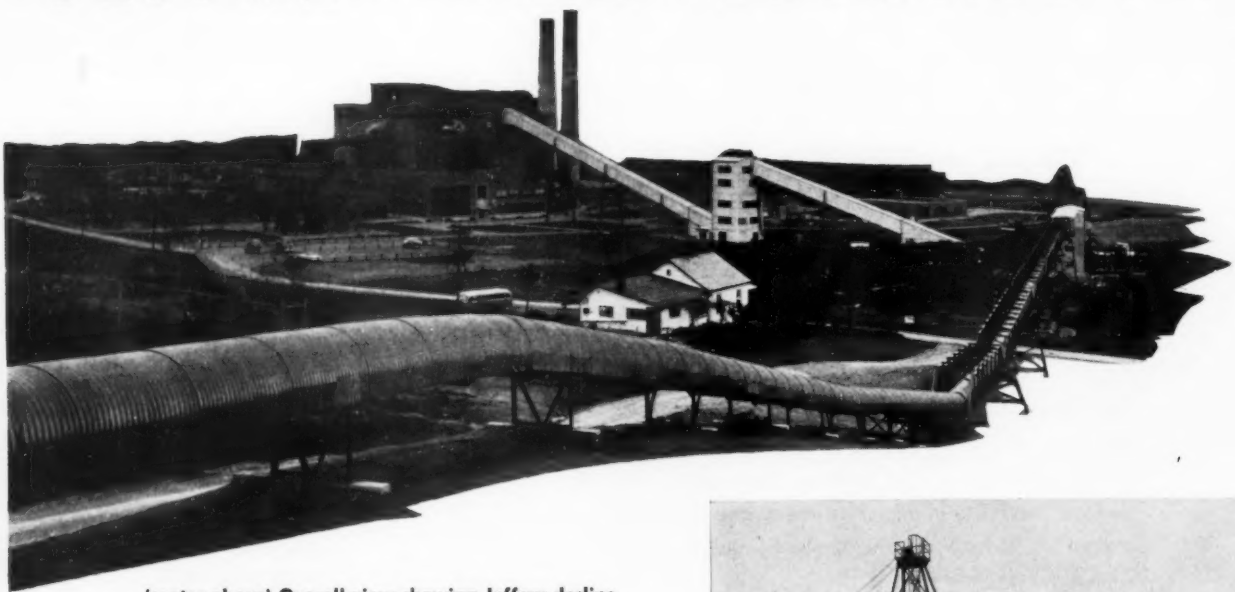
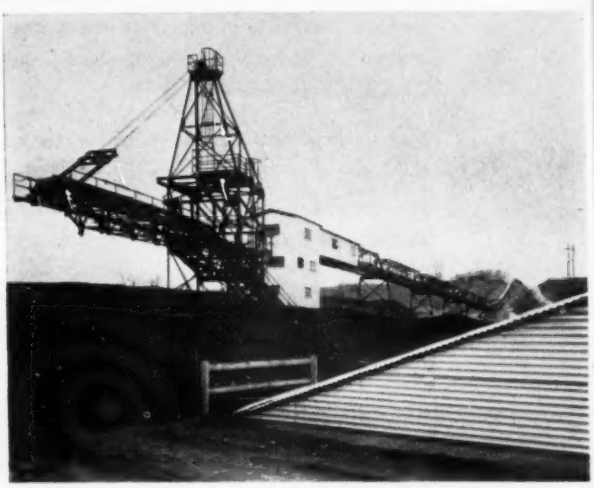
FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



JEFFREY ENGINEERING . . .





(center above) Overall view showing Jeffrey decline conveyor leading from transfer point to Jeffrey Boom Storage Conveyor.

(top left) Jeffrey No. 5150 Waytrol, at mine storage area, feeds coal at required rate and keeps automatic record of time and tonnage.

(top right) Decline conveyor leading down from transfer point. Note three-quarter covers for protection from sun and weather, open on lee side for easy and continuous inspection.

(right) Jeffrey Boom Storage Conveyor located to feed hopper over belt conveyors to power plant. Excess coal is moved to nearby ground storage.

300 tons an hour...570 feet per minute... at Columbus and Southern Ohio Electric Co. plant

The problem was to draw coal overland from a mine area 6,739 feet from the plant site of its Poston station. The road distance for truck or rail haulage was much longer.

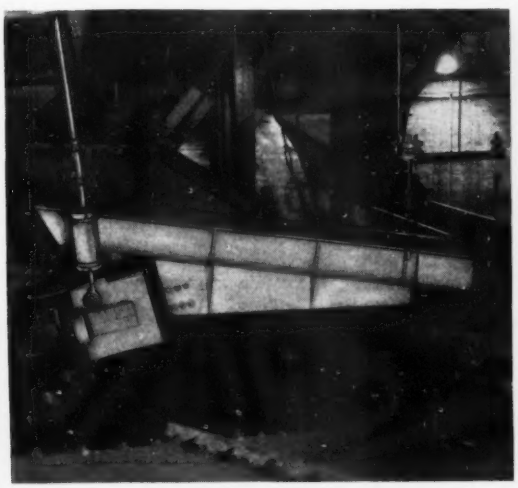
Careful studies indicated belt haulage by the direct route would be most economical. Jeffrey engineers were given the job of designing and installing what is believed to be the longest belt conveying system in the country using a 24" belt.

Coal for the Poston power plant now feeds in measured and weighed quantities from the mine supply by means of a Jeffrey Waytrol onto a 3,448 foot incline belt with a lift of 172 feet. This takes it to the transfer point where it starts a 3,291 foot decline to the plant. Both belts, 24" wide, carry 300 tons of coal an hour at 570 feet per minute over Jeffrey Reliance idlers.

At the discharge end a 36" Jeffrey Boom Storage Conveyor feeds the hopper. Two Jeffrey-Traylor Vibrating Feeders at the bottom of the hopper feed 300 tons an hour onto a 36" belt conveyor that rises to the crusher house. A 36" belt under the crusher carries the same 300 tons an hour into the plant to keep the big Poston bunkers continuously fed.

That's Jeffrey engineering . . . for the long haul, accurate weighing, the correct feed, and the proper size.

. . FOR THE LONG HAUL



Two Jeffrey-Traylor Vibrating Feeders at hopper bottom.

Jeffrey Crusher for reducing oversize coal to the desired stoker size.

Incline belt in gallery to Poston bunkers.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

• IF IT'S MINED, PROCESSED OR MOVED ...IT'S A JOB FOR JEFFREY!

GO on GREEN

as they will at

Murray Gill Station*

Kansas Gas and Electric Company

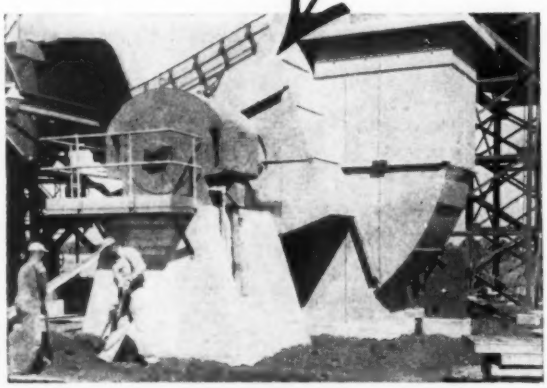
Wichita, Kansas

GREEN

Double Inlet ID Fan

Design capacity 256,500 cfm @ 383°F. 28.65" Bar; 10.16" SP; 705 RPM 595 HP. Special control type louvre inlet dampers; outlet dampers; inlet boxes; air-cooled bearings and sun shields.

The installation includes a Green Forced Draft Fan.



*Designed by Ebasco Services Incorporated

Two exacting buyers were involved in this installation: the owners and the consulting-design engineers. That they have entrusted to Green Fans the important work of supplying combustion air is in itself a stamp of approval. Their decision might be helpful to you in selecting fans for your power plant project.

We have been designing and making draft fans for 48 years. This is indicative of our experience. We have supplied fans for many of the leading utility and industrial power plants now under construction or recently completed. This is indicative of our modern designs and fabricating methods.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

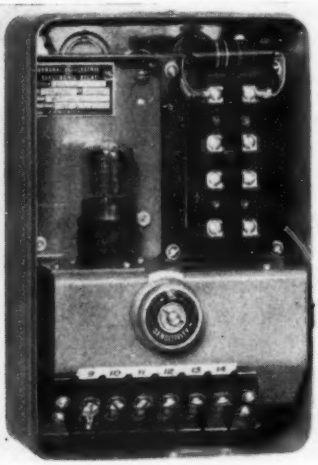
THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cindertraps
- Aerodyne Dust Collectors

BEACON 3, NEW YORK

More EQUIPMENT NEWS

Begins on page 152



Electronic Relay

909 • Electronic relay is said to be highly sensitive to resistance changes. It can be used for starting or stopping fractional hp motors, controlling liquid levels, operating lights, solenoids, and contactors wherever there is sufficient change in the circuit resistance.

Power requirements are 115/230 v ac, 50/60 cycles, and should not exceed 10 volt amperes. Time delay, depending somewhat on the dial setting and external resistance value, is rated at 5 milli-seconds minimum. Enclosure is weather resistant and dust tight, suitable for both indoor and outdoor installations. Bulletin GEA-5893. **General Electric Co, Schenectady 5, N. Y.**

For more data on these items, use post cards p 161. Identify your request with item number.

Dc Rectifier Welder

916 • New dc welder in 200, 300 and 400 amp ratings is built for heavy-duty service. Design incorporates fan-forced, up-draft

(*Continued on page 176*)

...with TYCOL lubricants on hand!

It pays to buy a "Diesel-Designed" Lubricant! ... It takes "something more than a motor oil" to counteract excessive wear in Diesel engines – and we proved it with Tycol Adeltran 40! In this instance, a Diesel engine was operated for one year with a competitive oil. An overhaul by the manufacturer turned up these conditions: all liners had to be replaced as well as piston rings ... 2 top compression rings were stuck and all rings were gummed up. After the switch to Adeltran (for the same operating period) liner wear was negligible ... filter life was considerably extended ... all rings were free and in excellent condition ... and owner reported an exceptionally clean engine base. For full details on Adeltran, contact your local Tide Water Associated office!

TYCOL
INDUSTRIAL LUBRICANTS

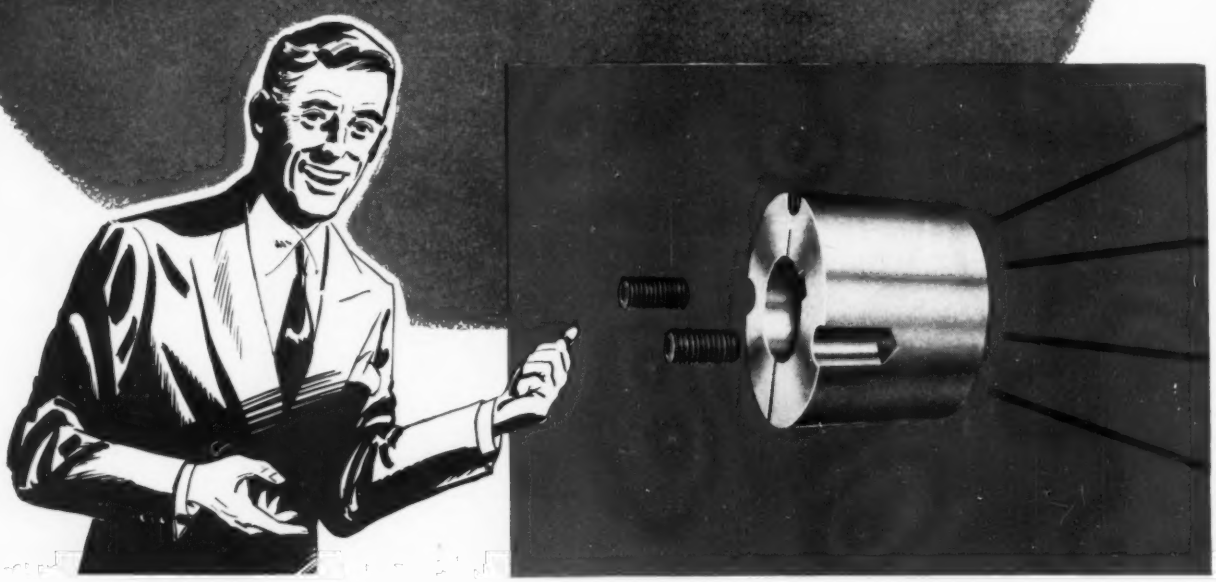
Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco
Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N.Y.

Over 300 Tycol industrial lubricants are at your disposal ... engineered to fit the job!

REFINERS AND MARKETERS OF VEEDOL ... THE WORLD'S MOST FAMOUS MOTOR OIL

Now-Standardize on TAPER-LOCK



Now, for the first time, you can have all the benefits of standardizing on a truly modern method of mounting wheels on shafts . . . through the famous Dodge patented Taper-Lock design.

The time-saving, cost-cutting performance of Dodge Taper-Lock . . . already proved in millions of installations of Taper-Lock Sheaves, Couplings and Conveyor Pulleys . . . is now available in a complete line of Taper-Lock Sprockets with Dodge Roller Chain.

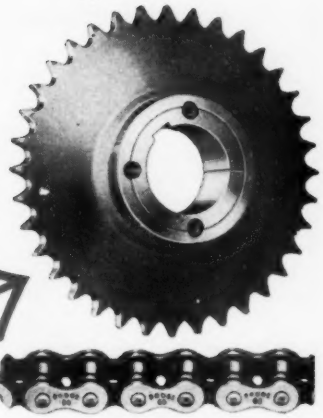
The bushing pictured here fits into the hub of every one of the Dodge products shown—sprockets, sheaves, couplings, conveyor pulleys. Both tapered bushings and hubs are precision machined to achieve perfect interchangeability. The result is less down-time on machines, simpler maintenance, reduced inventories. Taper-Lock gives you an unmatched opportunity to lower your costs and keep production rolling.

Dodge Taper-Lock grips the shaft for the full length of the bushing—holds with the firmness of a shrunk-on fit, yet comes off easily, quickly.

Taper-Lock's exclusive advantages were never more strikingly proved than in the new line of sprockets recently introduced by Dodge. For Taper-Lock brings to sprockets a new "off-the-shelf" availability. No time-consuming and costly reboring, key seating, drilling and tapping for set screws, needed to fit them to the shaft! Dodge Taper-Lock is available in both driver and driven sprockets from No. 40 to No. 100, up to 112 teeth. Taper-Lock bushings to fit shafts from ½" to 10" are available from stock.

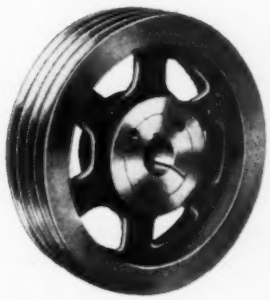
Consider carefully the cost-saving advantages you get by standardizing on Taper-Lock — the modern method of mounting wheels on shafts. For further information, call your Dodge Distributor, or write the factory.

DODGE MANUFACTURING CORPORATION, 3200 Union Street, Mishawaka, Indiana



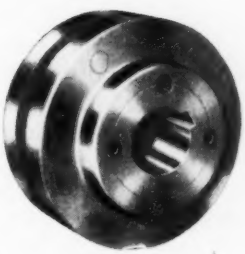
TAPER-LOCK SPROCKETS and Dodge Quality Roller Chain

— THE MODERN WAY TO MOUNT SPROCKETS



TAPER-LOCK SHEAVES

— THE MODERN WAY TO MOUNT SHEAVES



TAPER-LOCK COUPLINGS Rigid and Flexible

— THE MODERN WAY TO MOUNT COUPLINGS

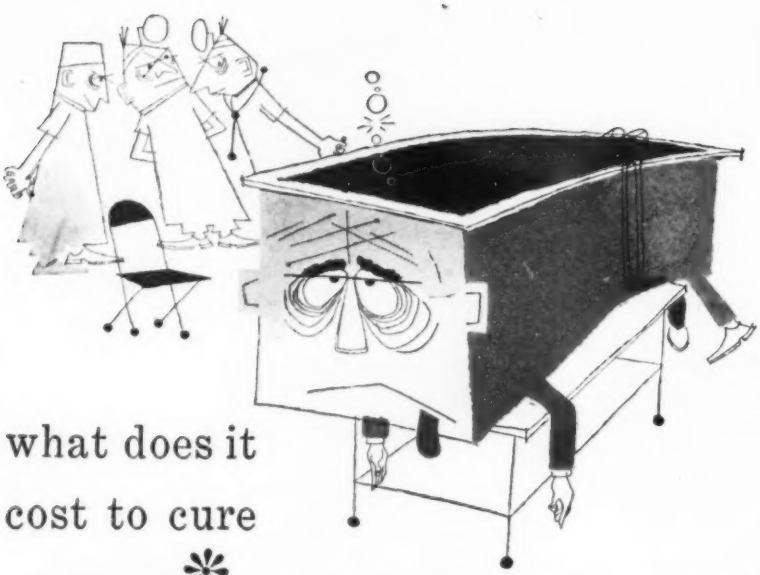
TAPER-LOCK SOLID-STEEL CONVEYOR PULLEYS

— THE MODERN WAY TO MOUNT CONVEYOR PULLEYS

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified phone book.

DODGE

of Mishawaka, Ind.



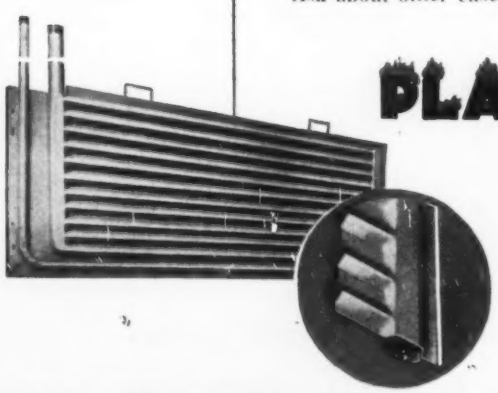
what does it
cost to cure
✻
coil-itis in your processing tank?

The constant care it takes to keep tanks operating when they're plagued with coil-itis is extremely costly. Downtime, and all the other maintenance time, slow heating and cooling ills of using old-fashioned pipe coils can be cured with Platecoils. As revolutionary as the new wonder drugs, Platecoils save as much as 50% in initial cost. They take 50% less space in the tank. They simplify maintenance and save hours of downtime. Compared to the hours it takes to clean and replace pipe coils, Platecoils can be cleaned and replaced in no time at all . . . without dumping the solution. It costs less to cure coil-itis with Platecoils than to suffer its evils. **Write for bulletin P79 today!**

PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

PLATECOILS COST LESS TO BUY, INSTALL, MAINTAIN

The Newcomb-Detroit Co., Grand Rapids Division, has found it is less costly to buy, install and maintain Platecoils than to fabricate pipe coils in their own plant. Ask about other case histories.



PLATECOIL
REPLACES PIPE COILS

✻

Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

PLATECOIL DIVISION, TRANTER MANUFACTURING, inc., LANSING 4, MICHIGAN

More EQUIPMENT NEWS

Begins on page 152

ventilation said to provide unusually cool operating temperatures and assure long rectifier life.

Metal and Thermit Corp, 100 E 42nd St, New York 17, N. Y.

Explosion-Proof Limit Switch

907 • Heavy-duty precision limit switch is designed for use on all types of machinery and industrial equipment in explosive gas or vapor-air atmosphere. Unit is listed by Underwriters' Laboratories as suitable for hazardous locations of Class I, Group C and D.

The new switch, type IMLI-EI, measures 6x2¼x1⅝ in. It is listed for 20 amp, 110, 220 or 440 v ac; ½ amp, 115 v dc; ¼ amp, 230 v dc; ¾ hp, 110 v ac; 1½ hp, 220 v ac. Pilot duty rating is 125 v ac; 6 amps normal, 60 amps inrush; 250 v ac; 3 amps normal, 30 inrush; 480 v ac, 1.5 amps normal, 15 inrush; 600 v ac, 1.2 normal, 12 inrush.

Minneapolis-Honeywell Regulator Co, Micro Division, Freeport, Ill.

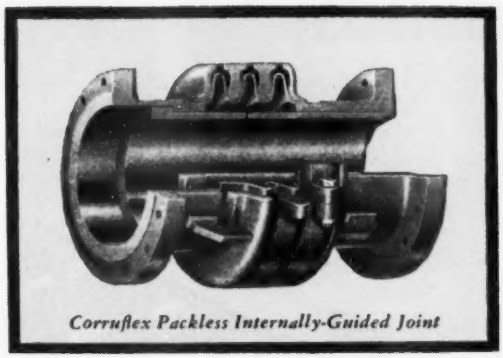
For more data on these items, use post cards p. 161. Identify your request with item number.

Insulating Varnish

958 • Electrical insulating varnish is designed especially for equipment where high speeds or intense vibration normally would cause wire movement and electrical failures. Irvington No. 140 was specifically formulated to meet exceptional standards of mechanical strength, also has high resistance to oils, chemicals and moisture, good electrical properties and excellent storage and dip tank life, manufacturer claims.

Irvington Varnish & Insulator Co, Sales Promotion Dept, Irvington, N. J.

(Continued on page 180)

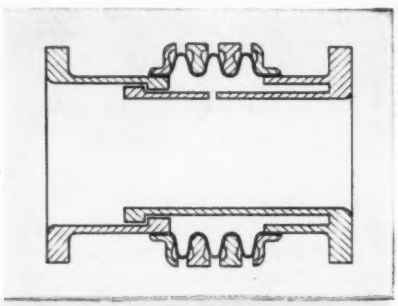


Corruflex Packless Internally-Guided Joint

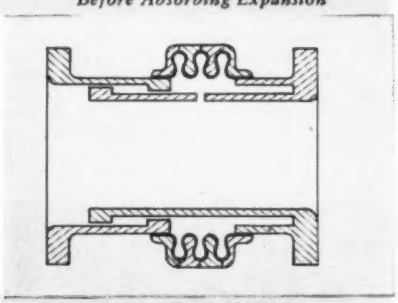
MASTERPIECE OF ADSCO ENGINEERING

Corruflex INTERNALLY-GUIDED EXPANSION JOINT

PROVIDES RIGIDITY IN SPECIAL PIPING PROBLEMS



Internally-Guided Joint Before Absorbing Expansion



Internally-Guided Joint After Absorbing Expansion

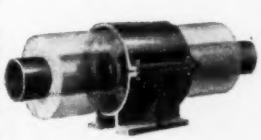
One of many reasons why Corruflex Packless Expansion Joints are so widely used by progressive engineers is the completeness of the Corruflex line. There is a Corruflex joint to absorb pipe expansion under *any* piping condition.

Suppose an engineer wants a joint which provides rigid construction against all movement except axial movement. ADSCO has the perfect solution — the Corruflex Internally-Guided Expansion Joint. No maintenance required because it is packless. Joint is built with an internal sleeve of heavy wall construction for effective guiding. Inner end of sleeve has a guide ring riding on a machined bore to insure true axial movement. Limit stop prevents the joint from being extended beyond its predetermined limit.

ADSCO makes the most complete line of expansion joints of any manufacturer in the world. That means complete engineering! Come to ADSCO for the *right* joint.

Don't let pipes get out of line

Use ADSCO Alignment Guides with ADSCO Expansion Joints. Cylinder is 12" long in all sizes, permitting pipe movement of 10". Damage to insulation prevented by ample clearance between guiding cylinder and pipe.



ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS • HEAT EXCHANGERS • STEAM TRAPS • STRAINERS • SEPARATORS • METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

valve values
PHOTO NEWS

Incubator for Ideas

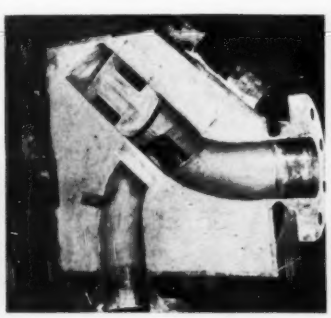
Edward's new Engineering Building, above, symbolizes the pride we take in our engineering staff. To house these men—whom we believe to be the most talented and experienced group of valve engineers to be found anywhere—we've constructed this building specially designed to permit them to operate at their highest possible efficiency. For example, the Engineering Building is immediately adjacent to our laboratories, permitting frequent and immediate consultation between engineers working with specific design problems, and laboratory research scientists.

Together, engineering and research maintain a rigid step-by-step control over all Edward operations. Nowhere is this more evident than in the development of a new valve to meet a customer requirement. Let's take a brief look at some of the steps in the production of one of Edward's latest designs.

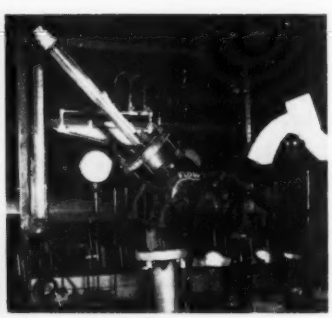
THE PROBLEM: **A prominent boiler manufacturer was designing a new unit to obtain increased efficiency from more rapid circulation of water within the boiler. They proposed to control this circulation by specially designed pumps. Special stop-check valves with absolutely tight shut-off characteristics were required to protect these valuable pumps from back flow of water from the boiler. Because of the low differential pressure in the circuit, pressure drop across the valve had to be kept to an absolute minimum.**

Product development committee first explored the problem thoroughly, then initiated a project . . .

. . . in research laboratory to determine basic fundamentals of design which were finally expressed in . . .



. . . plastic half models which were tested on flow machines. Lessons learned here were incorporated in . . .



. . . ¼ scale steel model given regular operating tests which suggested refinements for . . .

Edward Valves, Inc.

Another Product

... final full scale experimental model which was tested on complete flow hookup. Passing with flying colors ...

... the new model went to engineering for final determination of production techniques to be used and...

... detailed drawings for machinists and inspectors were made for use in actual production ...

... where it was under the constant supervision of inspection services guided by the Engineering Department. Finally we could deliver to the customer ...

THE SOLUTION: The new stop-check valve pictured above. Developed in 10 in. and larger sizes for boiler pressures from 1500 to 3000 lbs, this new valve easily meets the rigid requirements of perfect shut-off and minimum pressure drop. In addition, the original piping design called for a valve and elbow. A special design was evolved incorporating both of these into the valve, thus eliminating an elbow and weld at a substantial saving to the customer.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
1220 W. 144th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

COPYRIGHT 1953, EDWARD VALVES, INC.

Technical Tips

Closing Torques for Globe Valves Against High Pressures

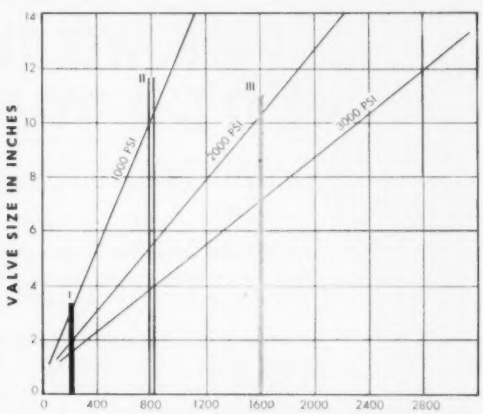
Where tight closure on high pressure lines is absolutely essential, globe valves are usually selected in preference to other valve types.

However, a simple calculation will show that it is almost impossible for one man to close a large globe valve on a high pressure line without some sort of mechanical aid. Edward provides this required mechanical advantage in the simplest, most inexpensive form through the highly effective Impactor handwheel.

In a globe-stop valve, the torque on the handwheel rim must be sufficient to generate a downward force in the valve stem at least equal to the pressure to be held under the valve disk times the area of the disk. This force varies directly with size and operating pressure. Deviations also arise from differences in the trueness of the two mating seating surfaces, packing friction, stem thread friction, and the ratio of stem diameter to handwheel diameter.

The chart below shows the approximate theoretical steady pull required on the rim of a handwheel to create a tight seat in Edward high pressure globe valves with operating pressures of 1,000, 2,000 and 3,000 pounds.

The average man cannot pull more than about 200 pounds on the rim of a handwheel. Therefore, some sort of supplementary closing device is needed for the pressures covered on our chart, in almost the complete range of valve sizes.



POUNDS PULL ON RIM OF HANDWHEEL

I. Limit of closing torque one man can exert by hand.

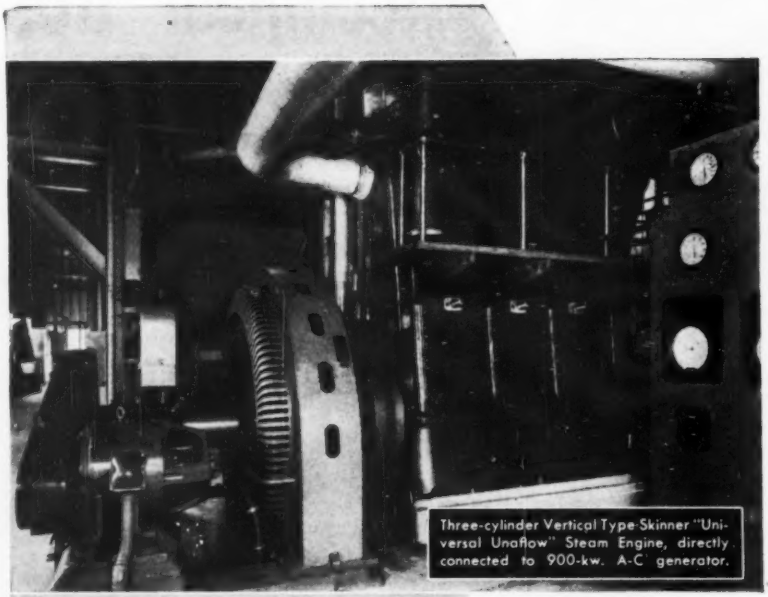
II. Torque one man exerts with ten blows of 12" Impactor Handwheel.

III. Torque one man exerts with ten blows of 36" Impactor Handwheel.

Lines II and III on the chart show the closing effect obtained by one man with two different sizes of Impactor handwheels. Line II shows the closing torque exerted by ten blows of a 12 in. Impactor handwheel, namely, four times the effect which would be obtained by the same man exerting only a steady pull. Line III shows the closing torque exerted by ten blows of a 36 in. diameter handwheel, eight times the unaided closing torque.

For some combinations of higher pressures and larger valve sizes on the chart, ten blows of either handwheel does not indicate complete closure. Additional blows with the Impactor will readily obtain drop tight closure in each case.

Edward



Three-cylinder Vertical Type Skinner "Universal Unaflow" Steam Engine, directly connected to 900-kw. A-C generator.

SKINNER "Universal Unaflow" STEAM ENGINE

Generates

ALL THE POWER THEY NEED... AND IT'S A BY-PRODUCT...

in this Bleachery and Dye Works

At the Great Falls Bleachery & Dye Works, Inc., Somersworth, N.H., production of steam for low-pressure processing is a necessity, and is one of the large operating costs.

Thanks to the economy of the Skinner "Universal Unaflow" Steam Engine, their electric power, instead of being a large operating cost, is obtained as a by-product of the bleaching and dyeing operations—*and at practically no cost.*

In spite of variation in power and steam requirements, the heat balance is sufficiently close so that exhaust steam is rarely wasted to atmosphere, and the engine generates all the power requirements of the mill.

The savings made to date through the installation of the Skinner Engine-generator unit indicate that the cost will be returned to the owners within three to four years. Write for case studies of what has been accomplished in industries similar to yours.

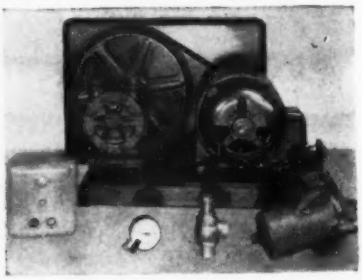
"Universal Unaflow" Steam Engines are built in horizontal types from 75 to 1200 hp.; in vertical types from 300 to 3000 hp.; and Skinner Marine Unaflow Steam Engines in capacities from 400 to 6000 hp.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 152



Fuel Oil Pump Sets

911 • *York-Power* fuel oil pump sets are available in four models for use with non-pump type burners and installations where more than one burner is involved or where an auxiliary method of oil transportation is required. Units use internal gears and are mounted on a structural steel base ready for operation. Capacities are 100, 225, 400 and 700 gph.
York-Shipley, Inc, York, Pa.

For more data on these items, use post cards p 161. Identify your request with item number.

Turbine Pump Motors

914 • Totally-enclosed explosion-proof vertical pump motors are now available up to 75 hp. The units have either hollow shaft or solid shaft construction, and are designed for powering turbine pumps in refineries, sewage disposal plants, dangerous, dusty or dirty locations, manufacturer states.
U. S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.

Rigid Steel Conduit

910 • New *G-E White* conduit is zinc-coated by a process called "metallizing," said not to harden the conduit or form brittle zinc-iron alloy. Advantages claimed are easier bending and wire-pulling characteristics improved corrosion resistance.
General Electric Co, Bridgeport 2, Conn.

(*Continued on page* 184)

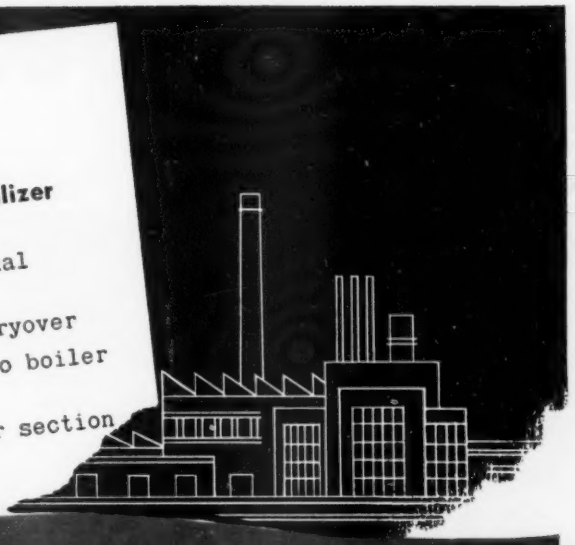
DREW TECHNICAL BULLETIN

DREW ORGANIC U-14-L

Antifoam, Sludge Conditioner and Stabilizer

Used in conjunction with conventional inorganic water treatment to:

a) Provide protection against carryover
b) Prevent sludge from adhering to boiler metal surfaces
c) Prevent deposits in pre-boiler section



DREW ANTIFOAM PREVENTS CARRYOVER

Anything other than dry steam going over from the boiler may lead to difficulties in boiler water systems. Drew Boiler Water Treatment includes highly effective products such as Drew Organic U-14-L for prevention of carryover.

A large food manufacturer in the mid-west was troubled with excessive carryover. Drew Organic U-14-L was recommended after a thorough analysis. It not only stopped the carryover, but also cleared up sludge adherence, which had long been a problem.

To prevent or eliminate industrial water problems in your plant, you'll get results faster and more economically with this Drew program:

1. Thorough study and analysis of the problem
2. Use of effective organic and inorganic products
3. Efficient methods of feeding products to the system
4. Control of dosages by simplified plant testing
5. Service by qualified field engineers
6. Technical assistance by the Drew Technical Department

Write for booklet "Drew Organics" and technical bulletins.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

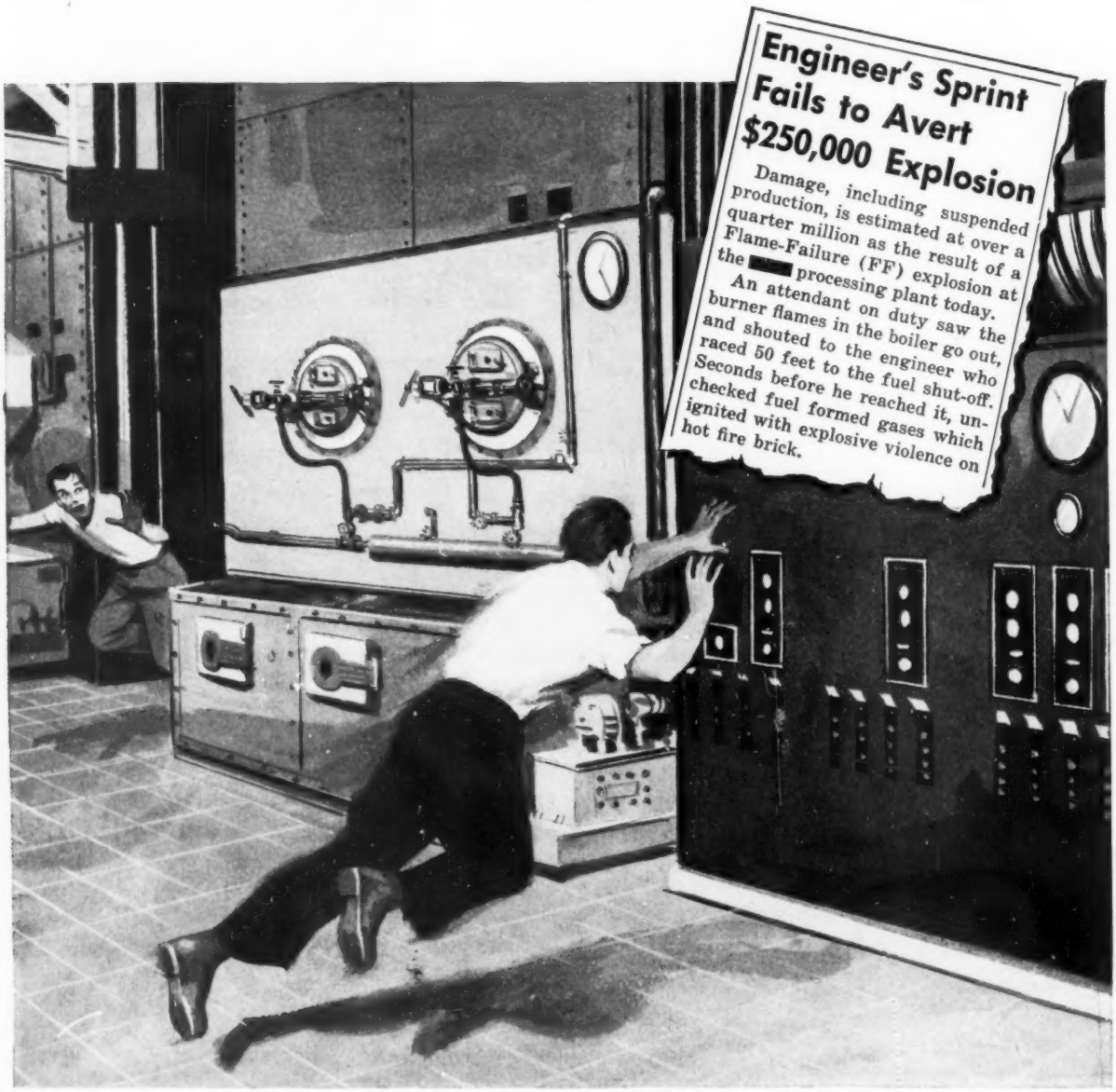
AJAX, ONTARIO

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS ASHEVILLE, N. C.

Service throughout the United States, Canada and South America

DREW PRODUCTS

This "FF" explosion was



Engineer's Sprint Fails to Avert $250,000 Explosion

Damage, including suspended production, is estimated at over a quarter million as the result of a Flame-Failure (FF) explosion at the [redacted] processing plant today.

An attendant on duty saw the burner flames in the boiler go out, and shouted to the engineer who raced 50 feet to the fuel shut-off. Seconds before he reached it, unchecked fuel formed gases which ignited with explosive violence on hot fire brick.

COVERING THE U. S. A. and Canada, factory-trained field engineers provide "know-how" of Flame-Failure safeguarding with FIREYE.

a matter of seconds . . .

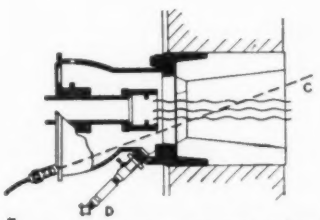
ONLY INSTANTANEOUS action can prevent explosion when a burner flame goes out. Explosive gases collect faster than any attendant can shut down fuel . . . faster even than most mechanical controls can function.

Today, insurance companies require automatic safeguards for commercial and industrial burners to shut off fuel in 2 to 4 seconds after a burner Flame Failure (FF). 4 out of 5 fuel burning plants do not have this protection. Most safeguards now in use actually require more than a minute for response. If *your* safeguard is that slow, you may be relying on no safeguard at all!

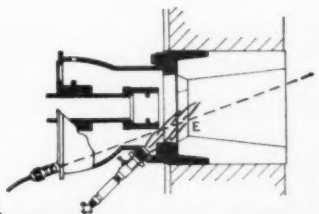
Act before it is too late in replacing slow, half-safe controls with the modern, fully approved FIREYE System . . . the only complete and instantaneous safeguard for all types of fuels. With FIREYE, an electronic eye "sees" the burner flame . . . works with the speed of light when it goes out, to cut off fuel and signal operating personnel.

Thousands of installations prove FIREYE has no equal for reliability. It can be applied to oil, gas, coal burners "overnight" – for a negligible investment.

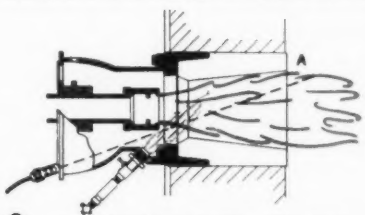
How fireye works to give you complete protection against "FF" explosion



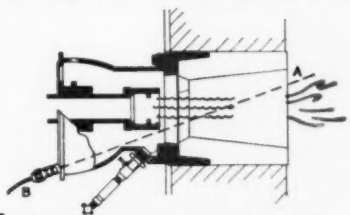
1. FIREYE purges combustion chamber (C) before igniting pilot (D). This eliminates dangerous gases which may have accumulated from leaking valve during down time.



2. FIREYE proves pilot flame (E) before turning on main fuel. Pilot may fail to light because of fouled electric ignitors, no fuel, or poor fuel-air mix.



3. FIREYE shuts down burner if main flame (A) is not ignited at end of safe-trial period (due to no fuel, poor fuel-air ratio or incorrect draft).



4. FIREYE shuts down burner in 2 to 4 seconds if main flame fails due to poor fuel-air ratio or draft, or fuel interruption. POSITIVELY PREVENTS EXPLOSION!

fireye®

PLAY SAFE! SEND NOW!

Why take chances?

Even with modern equipment, the chances are 4-to-1 you do not have complete Flame Failure protection. Send for this new "primer" on explosion hazards that tells how you can make simple checks on the equipment you now have.

COMBUSTION CONTROL CORPORATION
Dept. PB-9, 718 Beacon St., Boston, Mass.

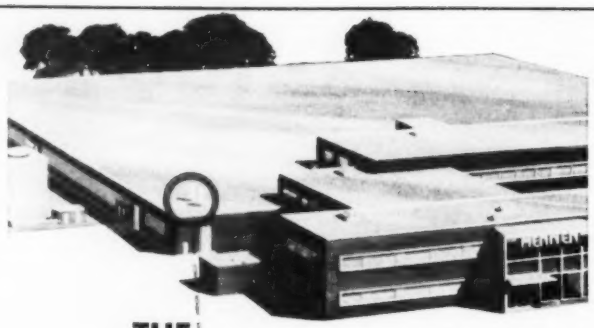
Send booklet "Guarding Your Properties Against Flame-Failure Explosions".

Name ..... Title .....

Firm .....

Address .....

City ..... State .....



THE MENNEN CO.

A. M. KINNEY, INC.
Architects & Consulting Engineers
Cincinnati, Ohio

Chooses

CYCLOTHERM*

CYCLONIC COMBUSTION

TO SOLVE A COMPLEX STEAM PROBLEM

The Mennen Company chose for their new ultra-modern plant and general office building in Morris Township, N. J., two 350 h.p. Cyclotherm Steam Generators to provide dependable steam for three separate and vitally important factors in their plant operation.

1. FOR PRODUCT PROCESSING

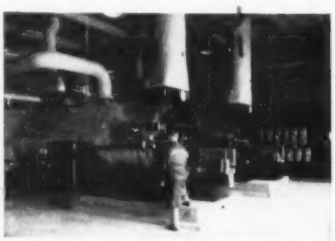
Constant steam is required for production in processing the many Mennen products. Cyclotherm has proven its reliability in thousands of installations throughout the world where steam loads vary, maintaining its high rate of efficiency and low rate of fuel consumption.

2. FOR AIR CONDITIONING

The Cyclotherm Steam Generators will provide 6,840 lbs. of steam per hour required to run two 180 ton absorption refrigeration units for Mennen's unique air conditioning system.

3. FOR PLANT AND OFFICE HEATING

To provide efficient heating for the 264,000 sq. ft. of plant and office space, Cyclotherm was again the first choice.



FIND OUT HOW Cyclotherm Steam or Hot Water Generators can give you: Guaranteed minimum efficiency of 80%; Full power from a cold start in 15 to 20 minutes; Increased savings on fuel and maintenance and many other advantages that are essential in your complex steam problem.

*Reg. trade name

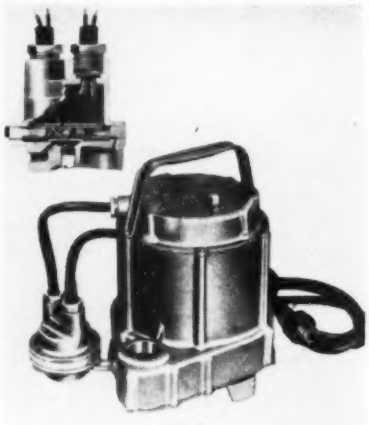
WRITE TODAY for your copy of "All Your Questions Are Answered by Cyclotherm." Just drop a card to Cyclotherm, Dept. 24, Oswego, N.Y.

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM DIVISION UNITED STATES RADIATOR CORP.—OSWEGO, NEW YORK

More EQUIPMENT NEWS

Begins on page 152



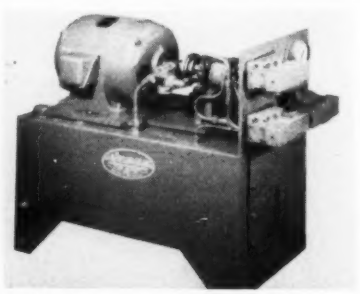
Submersible Sump Pump

959 • Model 109 is designed for completely submerged operation and will fit into a 12-in. cube. Maximum capacity is 3300 gph at 10 ft head.

The liquid level control switch has been redesigned, and is said to have four times the operating life of previous switches. It operates on the principle of water rising to trap air in the switch skirt. The compressed air flexes a diaphragm, makes the switch contact, and turns on the pump. When running, pump pressure flexes a second diaphragm in the switch to hold it on as long as water remains to be pumped.

Kenco, Inc, 1125 N Ridge Rd, Lorain, Ohio.

For more data on these items, use post cards p. 161. Identify your request with item number.



Hydraulic Power Unit

960 • Equipment consists of a 12 gpm hydraulic pump and a 7½ hp motor. Rest of hydraulic power unit includes a relief valve and three four-way control valves. The tank holds 50 gallons.

J N Fauver Co, Inc, 49 W Hancock, Detroit 1, Mich.

Safety Solvents

941 • New series of safety solvents cleans greasy, oily and dirty machine parts, is also recommended for degreasing and cleaning electrical equipment. The solvents have flash points ranging from 140 to 280 F.

Harco Chemical Co, 338 North Ave E, Cranford, N. J.

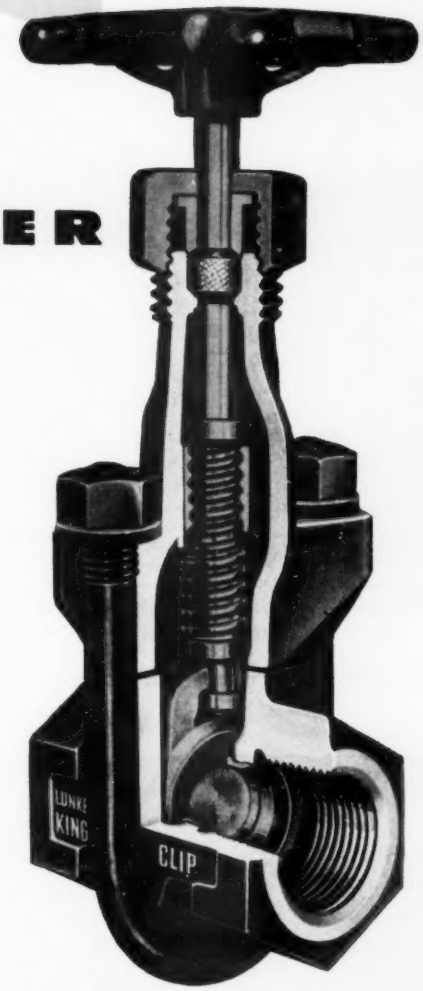
(*Continued on page* 188)

Tightest gate valve . . . . . you ever used!

the original clip valve with the NEW **non-slip®** *handwheel**

King-clip®

by **LUNKENHEIMER**



It closes tight . . . it stays tight . . . and here are four good reasons why:

The new Non-Slip Handwheel provides a firmer, more comfortable grip for closing — even when the operator's hands are wet or greasy.

The body provides unusual ruggedness — protects the valve against distortion from wrenching or pipe stresses . . . and the steel clip permits quick disassembly and reassembly.

Extra thread length prevents pipe ends from jamming against diaphragm or seat rings to force them out of line. Threads accommodate both A. P. I. and standard threaded pipe.

Stemalloy* stems, in the Iron Body Bronze Mounted patterns, have amazing resistance to thread wear. Millions are in use, and *not one* has ever been returned due to wear failure.

LUNKENHEIMER
QUALITY

BRONZE · IRON · STEEL

Ask your Lunkenheimer Distributor about "King-clip" — the original Lunkenheimer clip valve with cast-in drain channels and a bonnet-thread bushing for perfect stem alignment. For full details, request Circular 561 from your distributor or The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

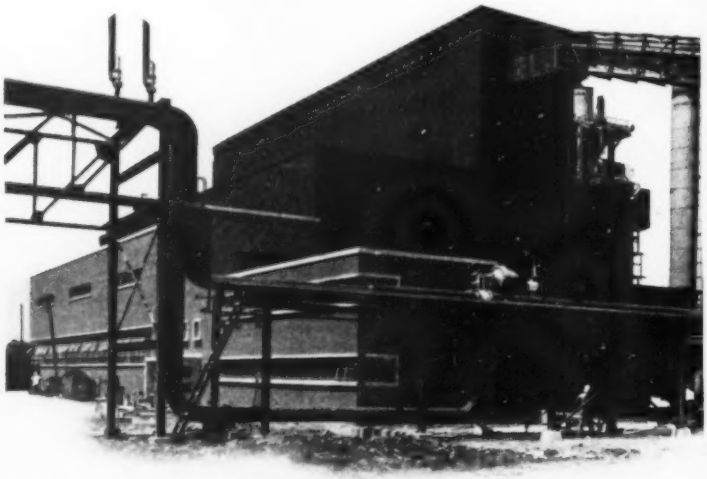
*Patented

LUNKENHEIMER®

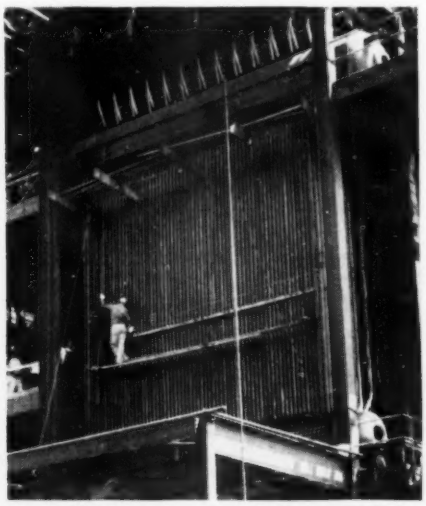
THE ONE *Great* NAME IN VALVES

L-753-4

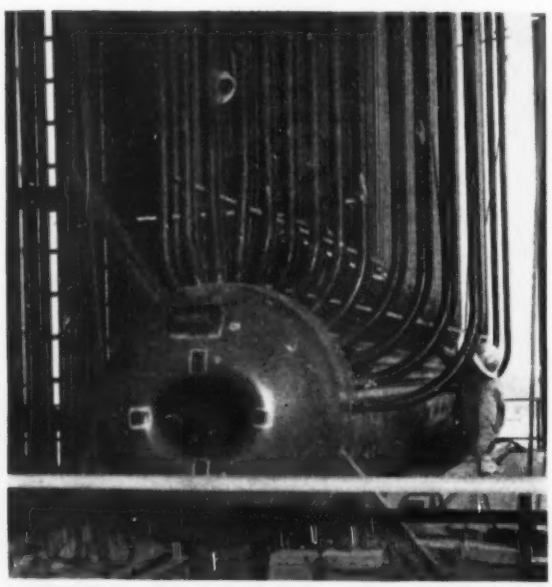
NEW PETROCHEMICAL PLANT USES



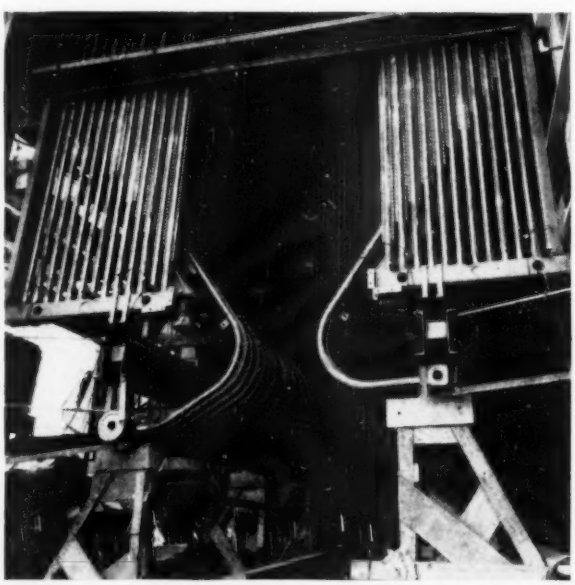
The new boiler house at National Petro-Chemicals plant, Tuscola, Illinois, will house three Combustion Superheater Engineering boilers with a continuous capacity of 200,000 pounds of steam per hour.



Erectors like the ease with which ELECTRUNITE Boiler Tubes can be expanded and inserted. Tubes enter drum holes easily because they are scale free, have uniform diameter, wall thickness and concentricity.

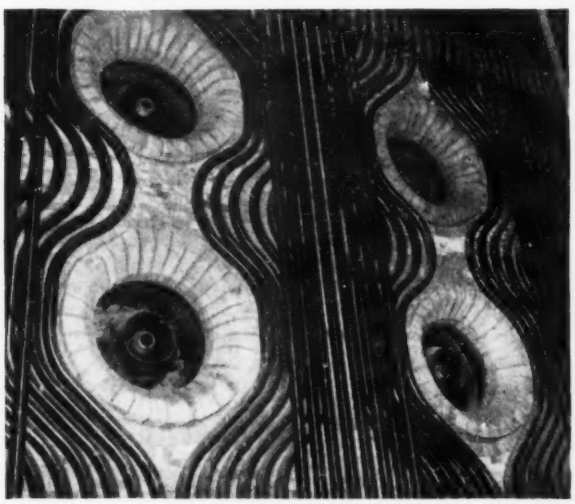


Uniform diameter of ELECTRUNITE Boiler Tubes makes them fit easily and quickly into boiler head drum holes. The result is a neat job in less time.

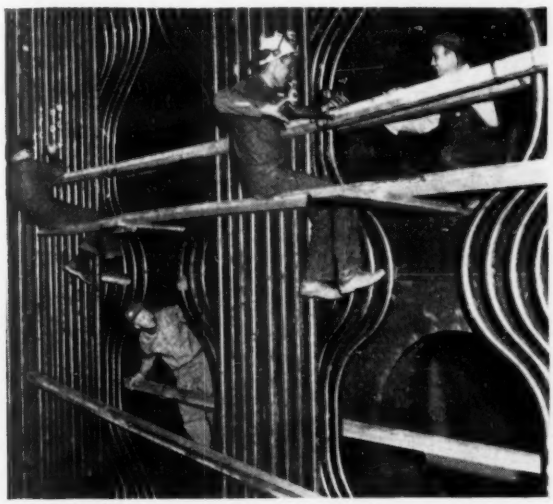


Workmen like the clean, scale-free surfaces of ELECTRUNITE Boiler Tubes because they're easier to handle, roll in easier.

ELECTRUNITE® BOILER TUBES



Ductility of ELECTRUNITE Boiler Tubes helps make different radius bends easily, exactly to the blueprint.



Bends like this are easily made with ELECTRUNITE Boiler Tubes because of their ductility. Spring-back can be calculated before the bending operation.

AT TUSCOLA, ILLINOIS, National Petro-Chemicals Corp. is constructing a huge new plant. Its three boilers will have a maximum continuous capacity of 200,000 pounds of steam per hour, 700 p.s.i. operating pressure, 750 degrees temperature.

Republic ELECTRUNITE Boiler Tubes were chosen for these boilers, which are being erected by Combustion Engineering Corp. Here are some of the reasons why:

1. ELECTRUNITE Boiler Tubes are made from flat-rolled steel, carefully inspected on both surfaces before roll forming.
2. Walls of the tubes are uniform in thickness, making heat transfer uniform all around the tube and from end to end.
3. Full-normalizing makes ELECTRUNITE Boiler Tubes uniformly ductile for smooth bending and roller expanding.

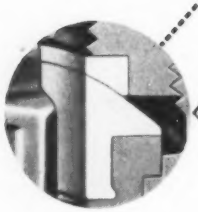
Whether you're planning long-range expansion . . . or retubing present facilities . . . it will pay you to get all the facts about Republic ELECTRUNITE Boiler Tubes. Write for booklet which gives data and specifications.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
221 East 131st Street • Cleveland 8, Ohio

REPUBLIC STEEL®
Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

ELECTRUNITE — THE ORIGINAL ELECTRIC WELDED BOILER TUBE

YES,
DARTS
HAVE
"Something on the Ball"



...it's Bronze-to-Bronze Seating in a True Ball Joint!

The drop-tight fit of a Dart is directly traceable to the precision grinding of its two bronze seats which form a true ball joint. No need to strain with a wrench — fastening and uncoupling are equally easy. Because the seats stay "healthy" Darts can be used over and over again — *to cut costs!* See your supplier today.

QUICK FACTS

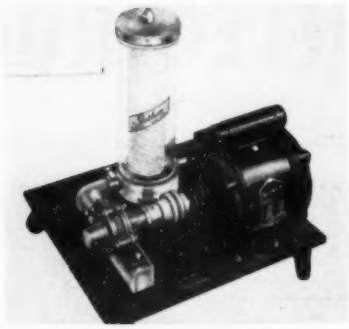
- Dart's heavy shoulders can withstand any amount and degree of wrenching
- Dart's extra-wide bronze seats resist pitting and corrosion
- Dart's nut and body are practically indestructible — they're air-refined, high test, malleable iron

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston•New York•Pittsburgh•Rome, Ga.

DART
UNIONS

More EQUIPMENT NEWS

Begins on page 152

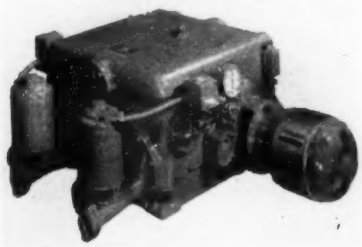


Laminated Fiber Filter Recharge

913 • Laminated fiber disk recharge is said to have four to ten times the useful life of cellulose, waste or redwood for full-flow filtering of large quantities of oil. The laminated disks remove foreign solids smaller than two microns and absorption of these solids after 48 hours of draining at 70 F is 2½ times the weight of the recharge, manufacturer claims.

William W Nugent & Co, Inc, 410-12 N Hermitage Ave, Chicago, Ill.

For more data on these items, use post cards p. 161. Identify your request with item number.

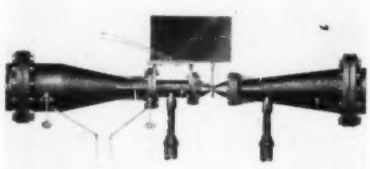


Vacuum Heating Pump

961 • New CSM pumps have low return line connection, said to greatly reduce installation costs. Air pumping and water pumping units are separate, each with its own motor and control. Each pump operates only when needed.

Capacity of the individual pumping units may be varied at will, permitting operating flexibility and capacity changes to accommodate additional radiation.

Nash Engineering Co, 436 Wilson Ave, S Norwalk, Conn.



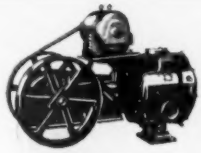
Sludge Controller

962 • Electrical transmission mechanical type sludge controller is an 8-in. diameter squeeze controller. It is said to overcome most of the difficulties of regulating heavy

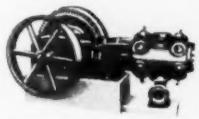
HEAVY-DUTY
"ES" COMPRESSORS

provide maximum efficiency in a WIDE RANGE OF APPLICATIONS

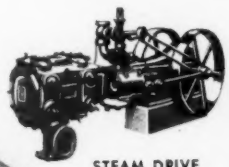
. . . with unusual flexibility of drive and cylinder arrangements



OVERHEAD MOTOR

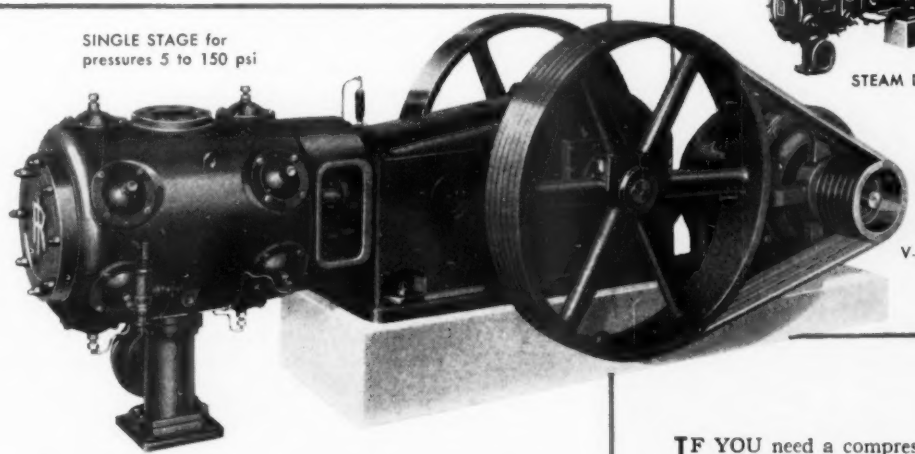


DIRECT-CONNECTED SYNCHRONOUS MOTOR

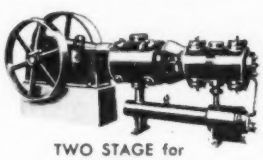


STEAM DRIVE

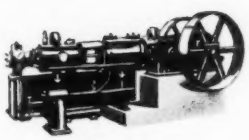
SINGLE STAGE for pressures 5 to 150 psi



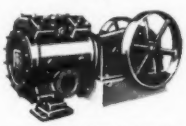
V-BELT DRIVE



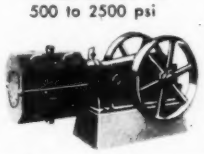
TWO STAGE for 150 to 500 psi



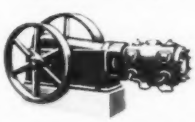
THREE STAGE for 500 to 2500 psi



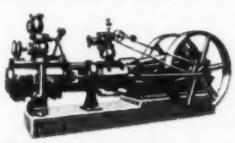
DRY VACUUM PUMPS . . . single or two stage



STEAM-PRESSURE BOOSTERS



NON-LUBRICATED CYLINDERS for oil-free air or gas



REFRIGERATION UNITS for ammonia or other refrigerants

IF YOU need a compressor for any of the following purposes you should consider the Type "ES" compressor . . . a standardized, yet extremely flexible compressor built by Ingersoll-Rand, the pioneer compressor builder.

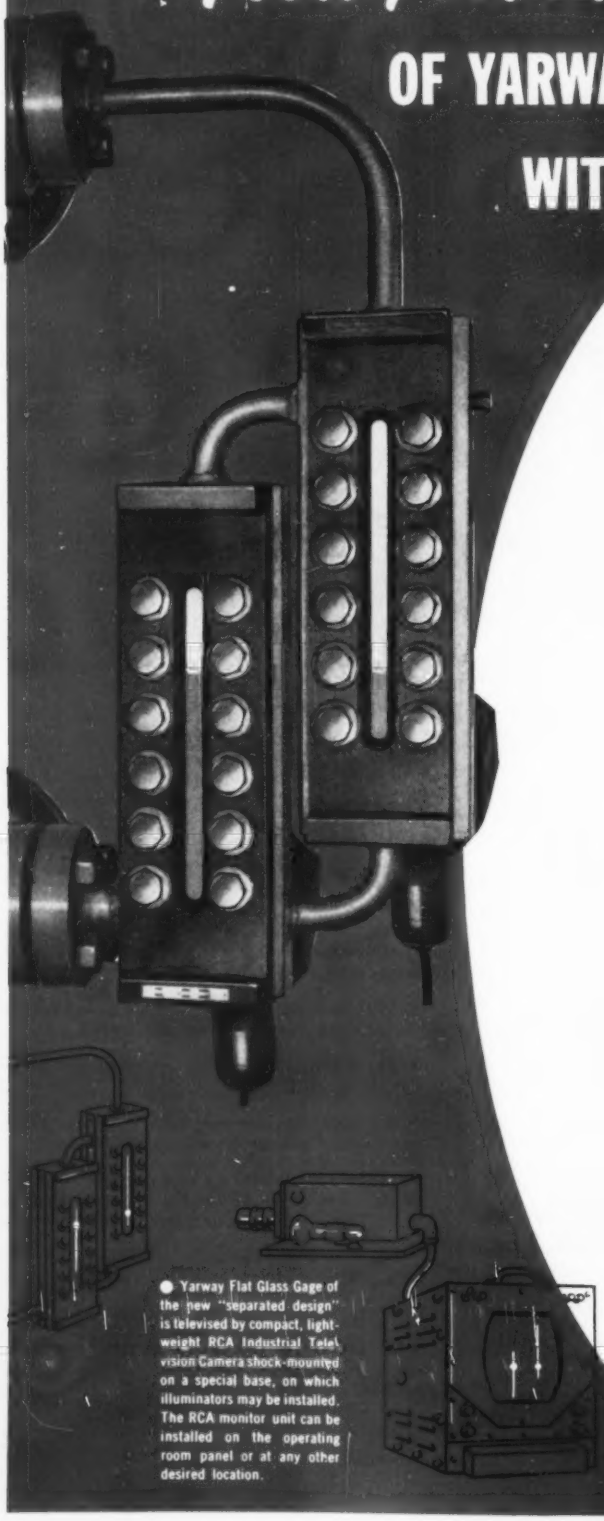
- To compress air or gas to any pressures between 5 and 2500 psi, or for pulling vacuums. (Stock cylinders are normally available for all frame sizes, see illustrations.)
- For capacities requiring from 5 to 125 horsepower. (Six frame sizes are available.)
- For continuous full-load operation day after day, week after week.
- For handling poisonous, inflammable, or other gases where leakage must be avoided.
- Where compressed air or gases must be free of all traces of oil. (Type NL cylinders require no oil, glycerine, grease or water for lubrication.)
- Where a future change in pressure conditions may call for a change in cylinder sizes.
- Where power cost is an important factor.
- To act as an economical standby unit for larger compressors whose full capacity is not required at all times.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. *Offices and Agents throughout the World* 859-1

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

Now Available... TELEVISION OF YARWAY FLAT GLASS GAGES WITH RCA INDUSTRIAL TV



● Yarway Flat Glass Gage of the new "separated design" is televised by compact, lightweight RCA Industrial Television Camera shock-mounted on a special base, on which illuminators may be installed. The RCA monitor unit can be installed on the operating room panel or at any other desired location.

RCA Industrial Television is now available for televising at a distance, boiler water level readings as indicated on Yarway Flat Glass Water Gages.

Yarway's broad experience in boiler water level indication, and RCA's leadership in the field of television, have been combined to give modern power plants "live" readings at any location in the plant.

This optional TV feature extends the already wide application of Yarway Gages in the steam power field. It is another of recent Yarway developments aimed at more accurate, more dependable, less costly water gage service.

Such features as the new *separated design with interconnecting expansion loops, Type "M" Illuminator* that causes the meniscus to shine like a star, the use of *tie-bar-type water columns, Yarway Welbond gage valves,* and *Yarway Pressure-sealed "floating assembly" gage glass inserts* make Yarway gages the modern gages for modern plants.

Your Yarway engineer will be glad to tell you about the new television feature, as well as the other Yarway advantages, or if you'd rather first have a descriptive bulletin, ask for Bulletin WG-1813.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

RCA Industrial TV

PRECISION INSTRUMENTATION FOR THE POWER FIELD

For precise reproduction of remote readings—for easy viewing of operations that are now too difficult to watch—RCA introduces sharp-focus, high-definition industrial television.

The RCA Vidicon camera tube packs a maximum of image resolution into its lightweight, heavy-duty TV chain. The Vidicon tube—only 6" long by 1" in diameter—operates on the same scanning principal as commercial television—provides a clear, crisp picture that you can trust for accuracy.

FITS ANYWHERE—OPERATES ANYWHERE

Because of its small size—because there are only two units in a complete RCA Industrial TV chain—RCA Industrial TV can be used practically anywhere.

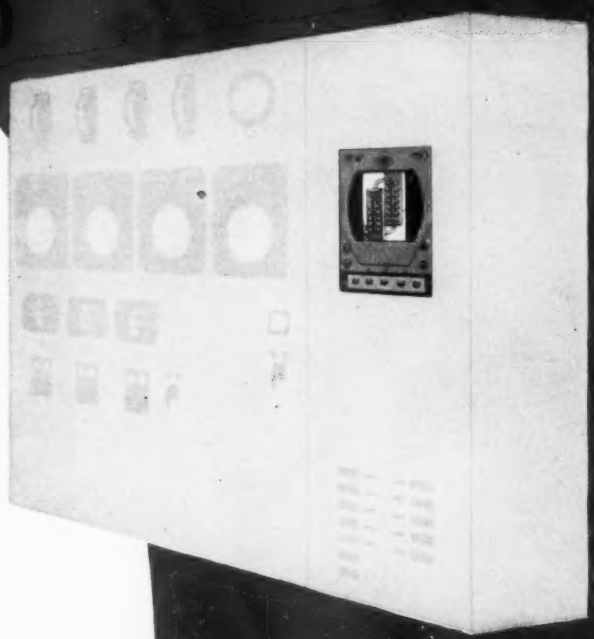
Typical power applications for RCA Industrial Television include: remote viewing of water level gages and meters; observation of internal furnace conditions; and smoke control.

- The following field-tested accessories—

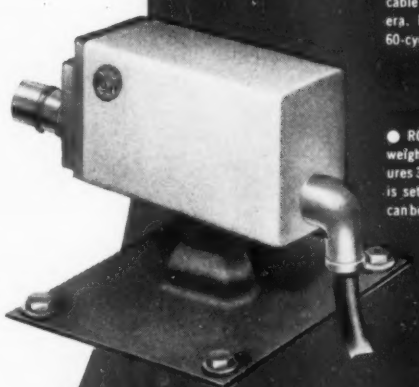
Furnace water-cooled lenses	Outdoor weather-proofed housings
Automatic iris control	Remote panning
Shock-proof mounts	Industrial auxiliary viewers

—make RCA Industrial TV practicable indoors or outdoors in high or low ambient temperatures.

FOR INFORMATION write RCA Engineering Products Dept., Camden, New Jersey.



● RCA Industrial TV monitor can be panel-mounted. Single cable connects monitor to camera. Power supply—110 volts, 60-cycle AC.



● RCA Industrial TV Camera weighs only 7½ pounds, measures 3" x 5" x 10". Once camera is set in place, all adjustments can be made from face of monitor.

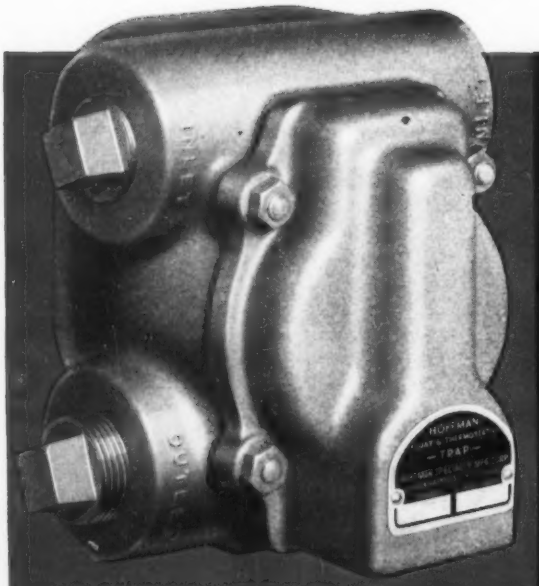
Industrial Products

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

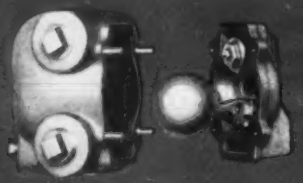
NEW HOFFMAN
FLOAT and
FLOAT and THERMOSTATIC
TRAPS



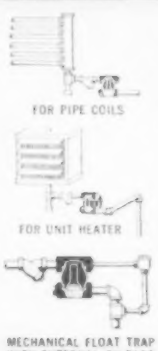
FEATURING:

1. Integral thermostatic air by-pass consisting of thermal element, seat, and cage—factory set and sealed.
2. Valve lever and seat assembly, constructed of brass stampings. Spherical steel copper clad float.
3. Stainless steel valve pin and valve seat—valve pin adjustable for positive seating.
4. All working parts mounted on the cover for easy accessibility—no pipe connections to break.

LOW MAINTENANCE COST



Float and Thermostatic Traps with cover construction so designed that all working parts of the trap are readily accessible. Once installed there is no necessity for the breaking of any pipe connection as all cleaning and repairing can be made by removing the cover of the trap.



Again Hoffman provides industry with an improved product, refined to *function more effectively and economically in removing condensate.*

Hoffman engineers thus anticipate industrial steam heating trends that demand less maintenance and operating costs.

The new 50 Series Float and Thermostatic Trap has an integral thermostatic air by-pass consisting of thermal element, seat, and cage, factory set and sealed assuring dependable service and easy maintenance.

The same fine Hoffman quality and precision workmanship prevails in these traps as in the other Hoffman heating specialties. The valve lever and seat assembly is constructed of durable brass stampings. The spherical float is copper clad steel. The valve pin, adjustable for positive seating, and the valve seat are made of stainless steel. Sizes are available from ¾" to 2"—pressure requirements of ½ lb. to 125 lb.

If you are planning to install low, medium or high pressure Float or Float and Thermostatic Traps, it will pay you to ask for Hoffman's new illustrated catalog sheet, available upon request.

HOFFMAN SPECIALTY MFG. CORP., 1001 York Street, Indianapolis 7, Indiana
Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensate Pumps

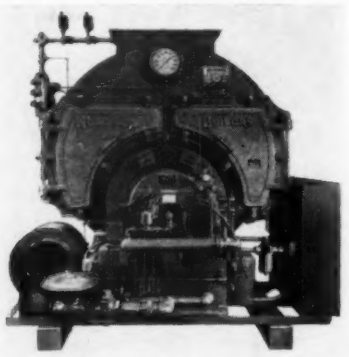
More EQUIPMENT NEWS

Begins on page 152

viscous flows even if corrosive.

Flexible rubber section has no pockets or restrictions that can trap particles. Essentially the unit consists of a venturi tube with a throat section of flexible rubber. Differential pressure in the venturi is transmitted to a rate setter that measures and maintains desired flow by adjusting the flexible throat area.

Simplex Valve & Meter Co, 68th and Upland Sts, Philadelphia 42, Pa.



Boiler-Burner Unit

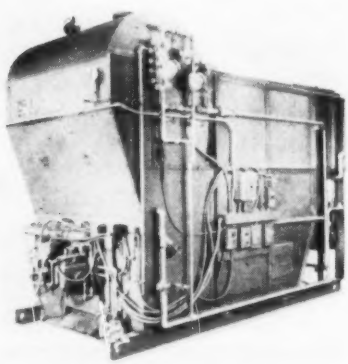
935 • Kewanee-Ray boiler-burner unit produces 39 to 456 certified output hp at 125 and 150 psi, or 15 psi steam or 30 lb water in sizes to produce 1,313,000 to 15,300,000 Btu hourly.

Manufacturers claim that unit is designed for forced-draft operation with a multi-stage secondary air control on the burner providing a constant velocity type air stream, to the combustion zone, with a high turbulence, high turn-down ratio and high CO_2 content.

Boiler, complete with controls, piping and accessories, is shipped from the Kewanee-Ross Corp plant; burner and accessories are shipped from the Ray Oil Burner Co factory.

Kewanee-Ross Corp, Kewanee, Ill.

For more data on these items, use post cards p 161. Identify your request with item number.



Packaged Boiler

963 • Cross-drum boilers are suitable for 100-200 hp output range. Firebox, pre-cast

Fittings on the hydraulic system of the famous Universal Coal Cutter, manufactured by The Jeffrey Mfg. Co., Columbus, Ohio, are PARKER trouble-free Triple-lok.

on coal cutters

Tube it up...Forget it...WITH PARKER

TROUBLE-FREE TRIPLE-LOK FITTINGS

Few machines get rougher use than coal cutters in coal mines. Subjected to severe vibration, caused by the action of the cutting head, and operating under the most adverse conditions, all parts must be ruggedly built, including the hydraulic system.

You'll find Parker Triple-lok Fittings on coal cutters and many other machines used in rough, rugged service because they are leakproof under the severest conditions of vibration, elevated temperatures, high pressures and repeated assembly. Parker Fittings meet the specifications of the A.S.M.E. Code for Pressure Piping, as well as J.I.C. and S.A.E. standards.

So *tube it up* and *forget it* . . . with Parker Triple-lok Fittings. Ask your Parker Distributor for Tube Fitting Catalog 4300, or write The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

This does it

Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

Precision Mark of

Leakproof Tube Fittings

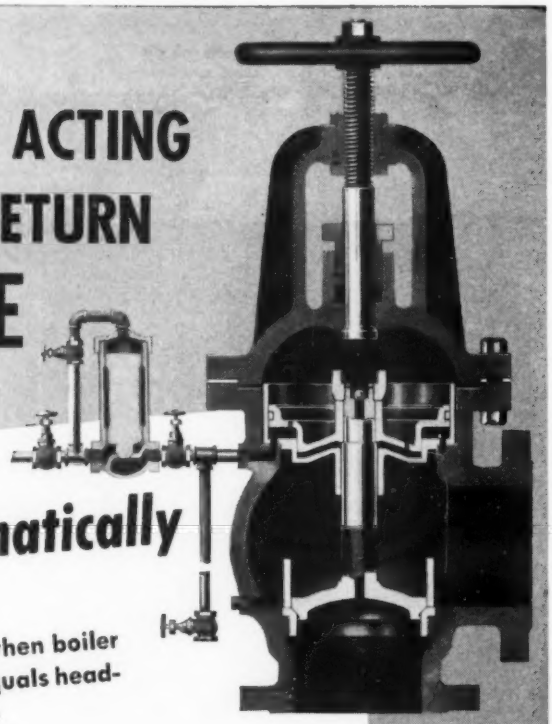
Parker

TUBE FITTINGS • VALVES • O-RINGS

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

This

TRIPLE ACTING NON-RETURN VALVE



Automatically

✓ **Opens** when boiler pressure equals header pressure

✓ **Isolates** and prevents back steam flow into a defective or lower steaming boiler

✓ **Prevents** boiler steam flow when steam line or header is ruptured.

GOLDEN-ANDERSON

also makes this Single-Acting Non-Return Valve

which will automatically open to cut-in the boiler when its pressure equals the header pressure and automatically close to isolate the boiler when its pressure decreases.

Bulletins S-1A and S-2 contain complete technical data.

GOLDEN ANDERSON Valve Specialty Company

2070 KEENAN BUILDING • PITTSBURGH 22, PA.

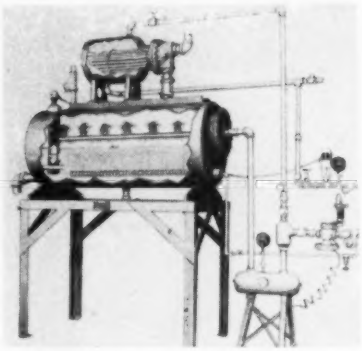
More EQUIPMENT NEWS

Begins on page 152

refractory walls and the complete water supply with pump, motor and tank are installed at the factory before shipment. Boilers are supplied ready for operation after fuel and water lines are connected.

Mund Boilers, Inc, 1600 N Indiana St, Los Angeles 63, Calif.

For more data on these items, use post cards p 161. Identify your request with item number.



Feed Water Deaerator

927 • *Zero-oxygen* deaerator is said to remove all oxygen and other non-condensable gases from feed water, and to integrate condensation recovery, deaeration, water storage and automatic boiler feeding into a single balanced system. Bulletin 575.

Fred H Schaub Engrg Co, 2110 S Marshall Blvd, Chicago, Ill.

Pipe Line Filter

964 • Small pipe line filters are designed for installations requiring 40 psi maximum pressure for compressed air or gas. Units feature one-bolt accessibility for inspection or cleaning without removing filters from line.

Made in two sizes, each size can use either absorption pad media to remove oil and water vapor or radial fin inserts to remove dirt and pipe scale.

Dollinger Corp, 11 Centre Park, Rochester 3, N. Y.

(*Continued on page* 198)

ANY RPM

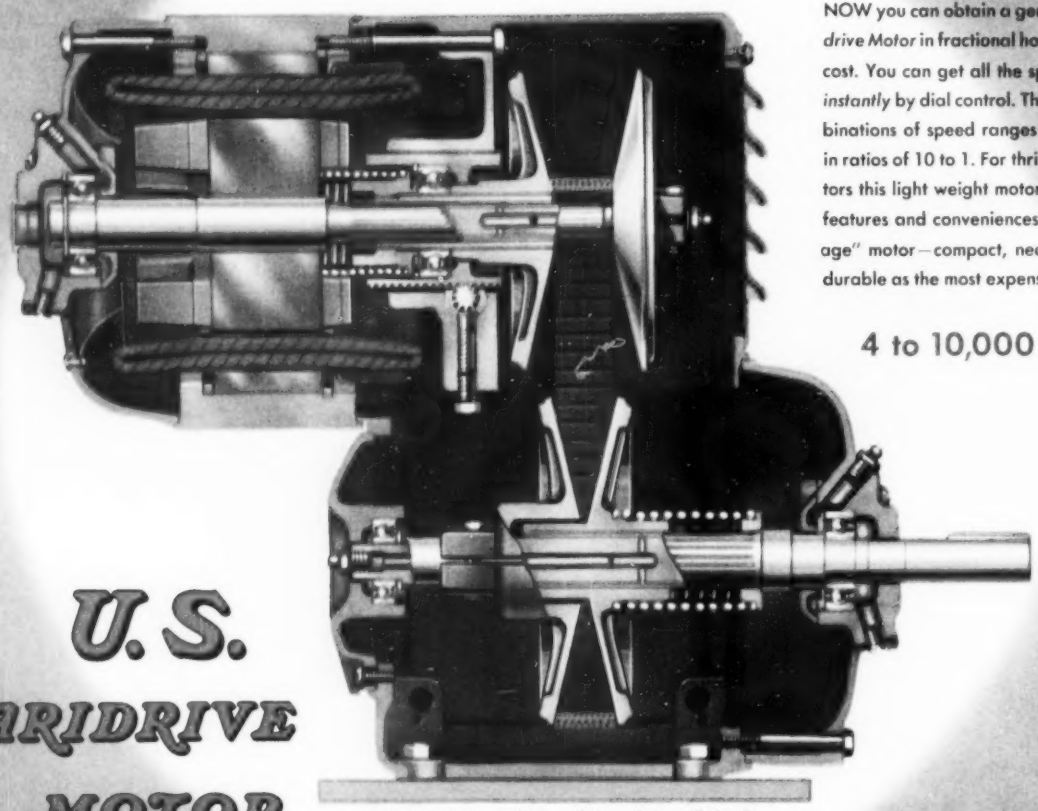
by simple dial control

TYPE **VA**
1/4 to 3/4 h.p.

U.S. VARIDRIVE MOTOR

The miracle motor for VARIABLE SPEED

LIGHT WEIGHT — FOR RUGGED INDUSTRIAL DUTY



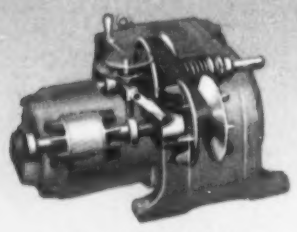
NOW you can obtain a genuine *U. S. Varidrive Motor* in fractional horsepower at low cost. You can get all the speeds you want *instantly* by dial control. There are 24 combinations of speed ranges to choose from in ratios of 10 to 1. For thrifty plant operators this light weight motor is packed with features and conveniences—a "one package" motor—compact, neat, light and as durable as the most expensive design.

4 to 10,000 r. p. m.

U. S. VARIDRIVE MOTOR

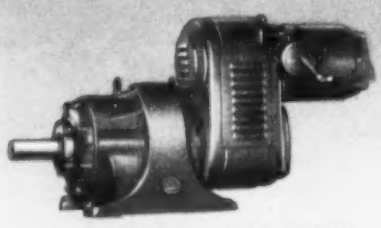
TYPE VA— 1/4, 1/3, 1/2, 3/4 hp

OTHER U. S. VARIDRIVE MOTORS, UP TO 50 H.P.



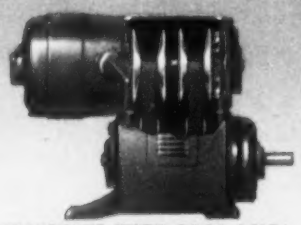
TYPE VE VARIDRIVE

Horizontal type. Take-off shaft can be positioned left or right. All Varidrives embody asbestos-protected windings, normalized castings, Lubri-flush bearings and centricast rotor.



TYPE VEV-GD WITH SYNCROGEAR

Combination type embodying Syncrogear, for extra low speeds and high torque. Varidrive unit is mounted on Syncrogear, upright as shown above, or can be set horizontally.



VARIDRIVE WITH DUAL BELTS

For extra heavy duty in larger capacities, dual belts are provided. Explosion-proof types and electrical or mechanical remote control also available in horizontal and upright models.

MAIL COUPON FOR VARIDRIVE BULLETIN

U. S. Electrical Motors, Inc.
Los Angeles 54, Calif. (Box 2058) or
Milford, Conn.

Send VA Varidrive Bulletin ☐ Other Varidrives ☐

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

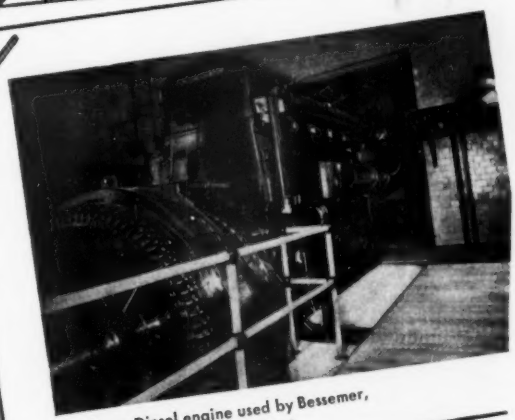
U.S. ELECTRICAL MOTORS, Inc.

PACIFIC PLANT: Box 2058, Los Angeles 54, Calif. ATLANTIC PLANT: Milford, Conn.

Atlanta 3, Ga.; Bakersfield, Calif.; Boston 16, Mass.; Chicago 8, Ill.; Cincinnati 16, Ohio; Cleveland 14, Ohio; Dallas 9, Texas; Detroit 2, Mich.; Fresno 1, Calif.; Houston 4, Texas; Indianapolis 4, Ind.; Milwaukee 2, Wisc.; Minneapolis 2, Minn.; New York City 6, N. Y.; Philadelphia 2, Pa.; Pittsburgh 2, Pa.; San Francisco 7, Calif.; Seattle 4, Wash. Sales and Service offices in all principal cities.

*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:



Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

EXCELLENT

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

Sam Kalember

Superintendent,
Bessemer Light Utility.

Note:

FOR TOP ENGINE EFFICIENCY, BESSEMER RELIES ON:

Cities Service DC-930 Oil used for crankcase lubrication!

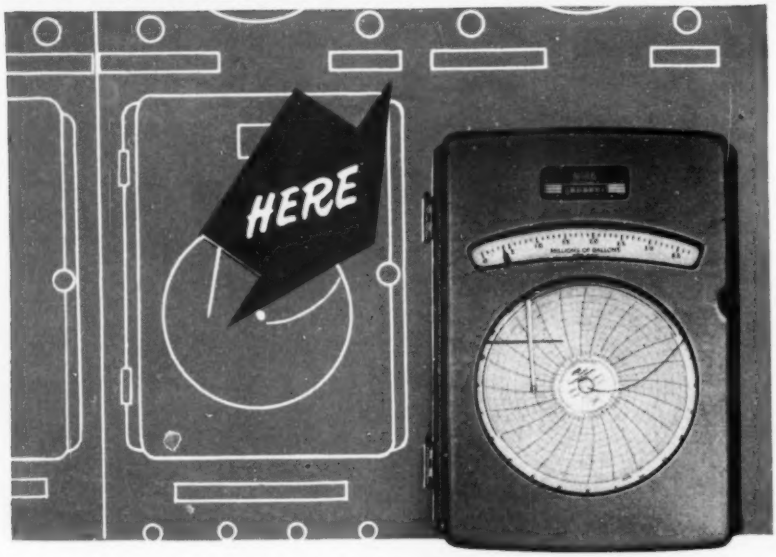
Cities Service DC-230 Oil used for power cylinder lubrication!

* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. I-16, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Get accurate boiler feedwater facts



Now you can keep track of boiler feedwater consumption with this Totalizer-Indicator-Recorder right at your central control panel. Builders Propeloflo Meter totalizes the flow on its direct reading register on the meter body — and can also transmit the accurate flow story over a simple two-wire circuit. The Propeloflo Meter is completely self-contained and self-operated, and requires no external power source. Standard designs are available for temperatures up to 275°F. and for 150# and 250# operating pressures. Power for the complete transmitting and receiving system (110 volt, 60 cycle A.C.) is supplied from the receiver end of the circuit. The receiving instrument may be panel, wall, or panel-stand mounted.

HERE GET THE FACTS— SEND COUPON TODAY!

BIF INDUSTRIES — BUILDERS - PROVIDENCE, INC. — BUILDERS
(DIVISION OF B-I-F INDUSTRIES)
354 Harris Avenue, Providence 1, Rhode Island

Please send Bulletin 380-J17 describing Builders Propeloflo Meter.

Name .....
Company .....
Street .....
City ..... State .....

More EQUIPMENT NEWS

Begins on page 152

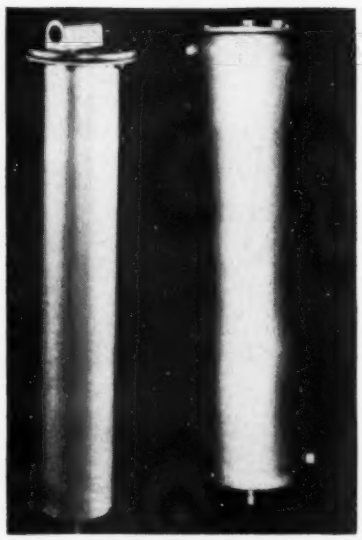
Industrial Chimney

965 • Insulated stack is made of refractory insulated wall, jacketed with aluminum. It cannot rust out, manufacturer claims, and requires no maintenance or painting. There is no danger of fire or fumes.

The stack comes in 36-in. sections that can be built up to any height. Overlapping joint hands and acid-proof high-temperature cement provide secure joints. Bulletin available.

Van-Packer Corp, Dept 000, 209 S La-Salle St, Chicago 4, Ill.

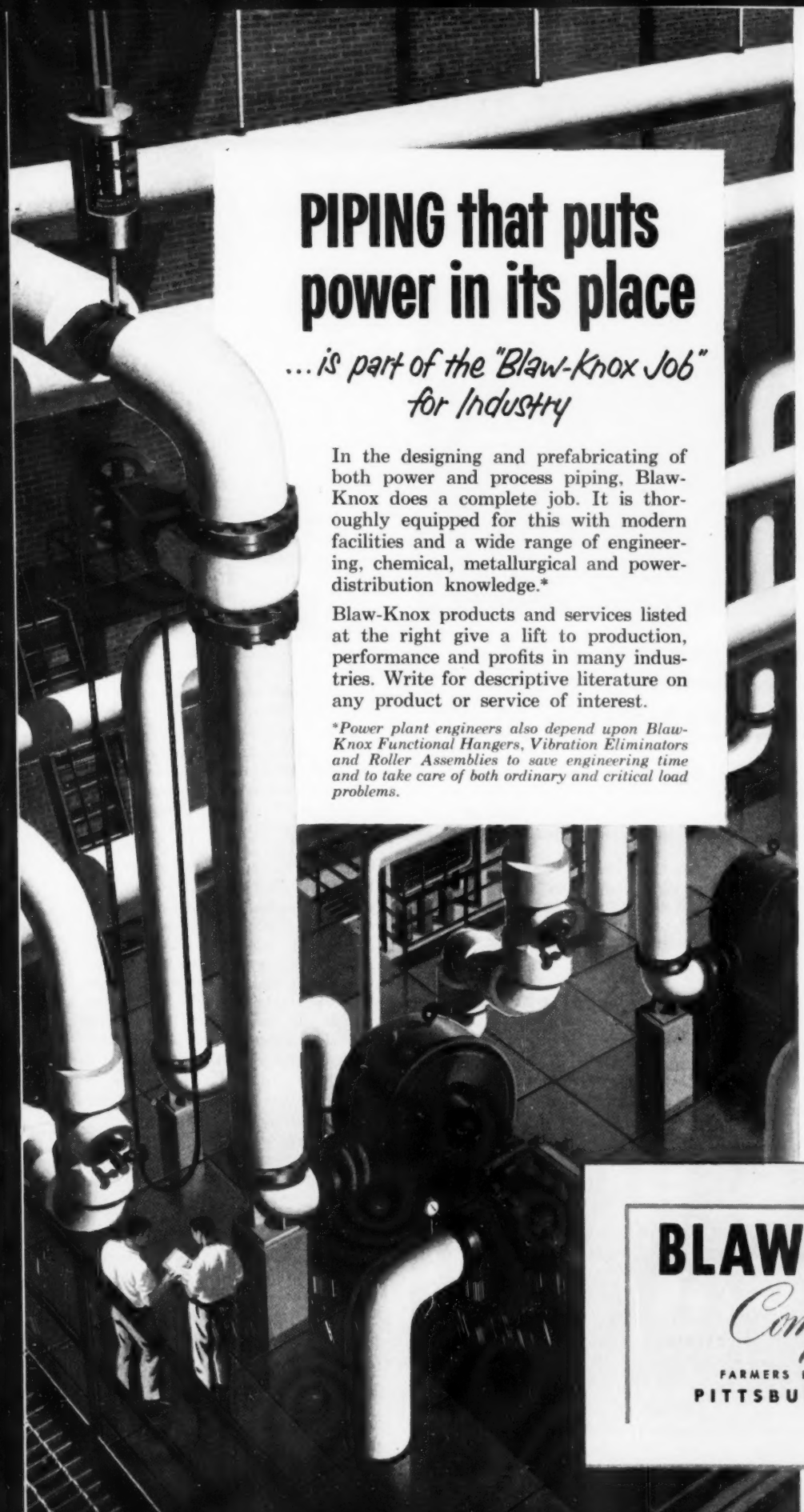
For more data on these items, use post cards p. 161. Identify your request with item number.



Heavy-Duty Air Line Filters

966 • New heavy-duty filters for removing water and oil from compressed air lines are tested for 500 psi. The steel outer shell has a 6-in. diameter, and is 36 in. long. Inner cartridge is 24 in. long, 5 in. in diameter and has a removable perforated bottom disk. It is packed with fiberglas.

Air-Line Engineering Co, 198 Wayne St, Mansfield, Ohio.



PIPING that puts power in its place

...is part of the "Blaw-Knox Job" for Industry

In the designing and prefabricating of both power and process piping, Blaw-Knox does a complete job. It is thoroughly equipped for this with modern facilities and a wide range of engineering, chemical, metallurgical and power-distribution knowledge.*

Blaw-Knox products and services listed at the right give a lift to production, performance and profits in many industries. Write for descriptive literature on any product or service of interest.

**Power plant engineers also depend upon Blaw-Knox Functional Hangers, Vibration Eliminators and Roller Assemblies to save engineering time and to take care of both ordinary and critical load problems.*

MEMBERS OF THE BLAW-KNOX "FAMILY" AND SOME OF THEIR PRODUCTS

Blaw-Knox Equipment Division
Blawnox, Pa.
- Concrete Road Paving Machinery
- Clamshell Buckets
- Contractors Equipment
- Gas Cleaning Equipment
- Open Steel Flooring
- Radio, TV and Transmission Towers
- Steel Forms for Concrete Construction
- Chemical and Process Equipment
- Water Cooled Equipment for High Temperature Furnaces

Buflovak Equipment Division
Buffalo 11, New York and Mora, Minn.
- Machinery for the Chemical and Food Processing Industries
- Specialized Machinery for the Dairy Industry

Chemical Plants Division
Pittsburgh 30, Pa.
- Complete Chemical, Petrochemical, Industrial and Petroleum Plants

Foote Construction Equipment Division
Nunda, New York
- Black Top Road Pavers
- Concrete Road Pavers

Lewis Machinery Division
Groveton, Pa.
- Rolling Mills and Auxiliary Machinery for Rolling Ferrous and Non-Ferrous Metals

National Alloy Division
Blawnox, Pa.
- Alloy Steel Castings for Extreme Temperatures, Abrasion and Corrosion Resistance

Power Piping and Sprinkler Division
Pittsburgh 33, Pa.
- Prefabricated Piping Systems for High Pressures and Temperatures. Pipe Hangers
- Automatic Sprinkler Systems for Fire Protection

Rolls Division
(Pittsburgh and Lewis Rolls)
Pittsburgh 1, Pa.
- Rolls for Steel and Non-Ferrous Rolling Mills

Union Steel Castings Division
Pittsburgh 1, Pa.
- Heavy Steel Castings

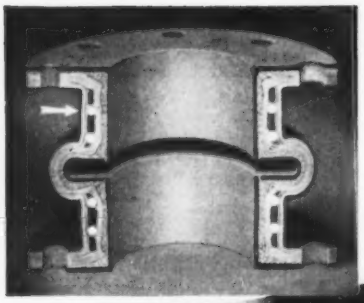
BRANCH OFFICES:

Birmingham 3, Alabama
Chicago 3, Illinois
Philadelphia 3, Pennsylvania
New York 17, New York
San Francisco 5, California
Washington 5, D. C.
Tulsa 1, Oklahoma
Export—New York 17, New York

© 1953 Blaw-Knox Co.

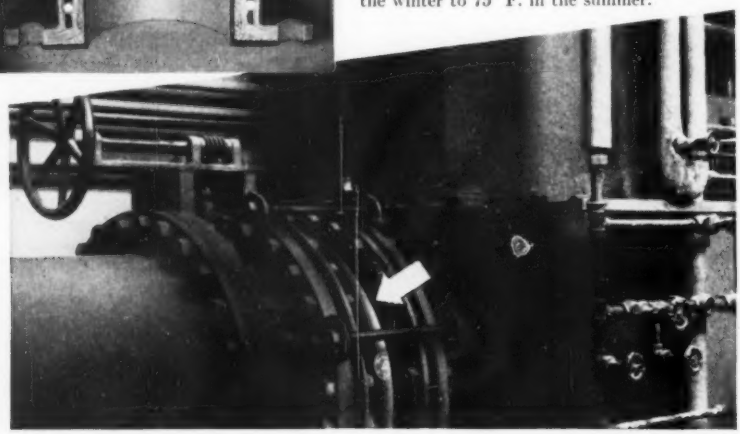
BLAW-KNOX Company

FARMERS BANK BUILDING
PITTSBURGH 22, PA.



LEFT: Sectional view showing sturdy construction of a Garlock single arch spool-type expansion joint. Arrow points to one of steel reinforcing rings.

BELOW: Garlock 204 spool-type rubber expansion joint installed on a 30" pipe line connecting a propeller-type circulating water pump at the N. Y. State Electric & Gas Corp., Greenidge Station, Dresden, N. Y. The water temperature varies from 33° F. in the winter to 75° F. in the summer.



Forget about pipe line expansion and contraction due to temperature changes . . .

INSTALL GARLOCK EXPANSION JOINTS

Garlock rubber expansion joints relieve stresses and strains in pipe lines and connected equipment. These flexible joints absorb vibration and compensate for linear expansion and contraction of the line. In short, they greatly reduce maintenance costs on piping and connected equipment.

Garlock rubber expansion joints are used in central power stations, factory power plants, pumping stations, paper and pulp mills, ships, etc. They are made in all pipe sizes from ¾" to 72", round, rectangular, tapered, off-set, spool-type, and U-type. Neoprene expansion joints for oil service and "Teflon" expansion joints for chemical service are available.

CHECK THESE 8 ADVANTAGES:

1. Made of high-grade rubber, they do not crack or fracture under repeated flexing.
2. They do not take a permanent set.
3. For pressures up to 125 p.s.i. (depending upon size of joint); and for vacuum of 30 in. of mercury.
4. Suitable for operating temperatures up to 180° F.
5. They do not corrode or erode.
6. They are light in weight and can be installed in a limited space.
7. They require no gaskets between the flanges of the joint and the flanges of the pipe.
8. They do not induce electrolysis.

Get All the Facts. Send for Descriptive Folder No. AD137.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

Branch Offices in Most Principal Cities

GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

RECIRCULATING WATER

Continued from page 89

pH requirements has sometimes caused the treatment to fail. Metaphosphates are intermediate in cost between inorganic and organic chromates, and the alkaline salts usually required for controlled carbonate scale treatment. They can be justified for use in closed systems that do not have excessive losses of water.

Performance Factors. All the above inhibitors, though, involve an understanding of these next paragraphs on influencing factors:

1. *High temperatures* always need watching, particularly for chromates (inorganic or organic). Protection may fail in hotter sections of a tubular exchanger. (Several operators point out that, because of this, tube sheet, exchanger head or tube end inspections may not be enough.)

2. *Pit Corrosion.* If ever the protective film is broken, corrosion proceeds very rapidly. Oxygen corrosion is more aggressive than on an unprotected surface because concentration cells form. A second reason is that total corrosion rate is not reduced but concentrates on the small, exposed area.

3. *pH Value.* Phosphate films are more effective at low pH values (6.0), organic chromates at pH of 7.0 or above. Metaphosphates revert to orthophosphate under a high pH (over 8.5), high temperature (about 120 F), high saturation index (1.0-1.5). Then a sludge forms on tube surfaces and prevents renewal of a protective film.

4. *Preparation.* Flush out the system, remove mud, wood chips, etc. This foreign material may blank off parts of the tube surface or cause too high stream velocities in sections so film cannot be laid down rapidly enough. Be sure surface is free and clean of all previous corrosion. Otherwise, corrosion can get started on the old cells.

5. *Protective Film.* These films require constant renewal under a swift-moving water flow. Corrosion increases rapidly with velocity when ferrous hydrate films are involved. So chemical concentrations must be maintained without interruption.

COOLING TOWER

Certainly the cooling tower as a vital part of the open recirculating system, Fig. 7, deserves every care for long service life. Its problems brought on by water troubles are highly special.

Water constantly recirculated over cooling towers is reaerated and, hence, aggressive to metal, principally ferrous. So towers should be made of nonferrous materials, or have all metal parts coated

NO GETTING AROUND IT!

De Laval Oil Purifiers Give Double Protection

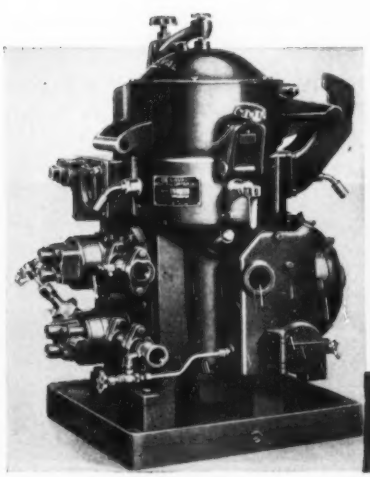
There's no avoiding the fact that a turbine requires protection from *two* troublemakers—dirt and water. Any device that removes only the dirt does only half a job.

That is why De Laval Oil Purifiers are so much more effective for maintaining the purity of turbine oil than any other means available. They not only remove solid contaminants but also any moisture that may be present.

It is important to get such ***double protection,*** for oftentimes water, rather than dirt, is the real source of contamination. For example, condensate in oil leads directly to the formation of sludge, and, of course, if a water leak should ever develop, serious emulsification and real trouble might occur.

De Laval Oil Purifiers do not remove oil-soluble additives. The purifying action is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco



DE LAVAL

for more dependable power production

LUBRICATING OIL PURIFIERS

Close-up view of leaf-type filter used with Sorbo-Cel by Pullman-Standard

How Pullman-Standard operates boilers on a

1% blow-down basis...

with SORBO-CEL

At the Haskell & Barker plant of Pullman-Standard Car Mfg. Co., Sorbo-Cel solved the major filtration problem of removing oil from condensate returned to the two new 50,000 lb-per-hr 400 psi, 750-F boilers.

Pre-Coat Sorbo-Cel and regular Sorbo-Cel, specially processed high flow-rate diatomaceous silica powders, are used on leaf-type filters. After a film of Pre-Coat Sorbo-Cel has been built up on the filter screens, regular Sorbo-Cel is added continuously to the unfiltered water. This means a new filter surface is constantly presented to the oncoming water.

Results . . . Water filtered by Sorbo-Cel contained less than 0.1 ppm of oil . . . and boilers have since been operated on a *one per cent* blow-down basis.

Send coupon below for bulletin giving data on this low-cost way to remove oil from water. No cost or obligation.

Johns-Manville
SORBO-CEL

Johns-Manville POW. 9
Box 60, New York 16, N. Y.

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

RECIRCULATING WATER

Continued from page 200

with paint or other corrosion-resisting coating.

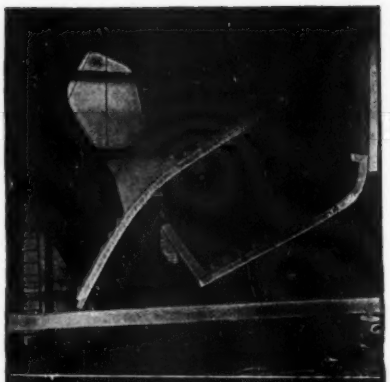
Wood has its own troubles. It suffers from action of concentrated salts left behind by evaporated circulating water or by fungus growth. Concentrated sodium salts are particularly destructive. Resins are leached from the wood, material softens, and fibers are frayed under these sodium salts, Fig. 3, 4, p 86. One way of preventing this weakening of the wood is by periodic washing down. But be careful not to flush the fibrous material into pumps, other equipment. The chemical attack goes like this. Pulping or delignification develops because neutral salts at high temperature and pressures act as acids to degrade cellulose. What's more, all oxidizing agents attack lignin. Later drying of alkali-impregnated wood, as when you shut down a tower, is serious because the swelling action of the alkali on the cellulose promotes oxidation and, therefore, attack. This drying action on wood impregnated with mineral acids, or salts that hydrolyze to acids, makes wood brittle because hydro-cellulose forms.

Biological factors also wage war on cooling-tower structures. For example, bacteria attack sugar, starches and some forms of cellulose, but it is doubtful if any of them actually decompose wood. Simple fungi, or molds, decompose cellulose in soils and composts, and attack various parts of living plants and decompose hemicellulose, especially in partially decayed woods. The fleshy fungi are the true wood destroyers, and most of them attack cellulose and produce "brown rot." Some species destroy lignin and produce the rarer "white rot."

R D Baker, Marley Co, has discussed the effect of fungi as a contributing factor on various types of wood. Decay from this cause is not confined to any one make, type or location. Attacks have been found in atmospheric deck towers, forced-draft and conventional induced-draft towers, and in double-flow towers.

Fungi will not attack wood that is either too wet or too dry. For this type of attack, moisture content must be in excess of fiber saturation; 40 to 50% is considered optimum. Decay does not occur in submerged wood, but it has been found in redwood eliminator slats, removed from a cooling tower when the moisture content was 265% of the dry weight. Optimum temperature for fungi is between 68 and 86 F.

Cellulose resists most chemicals, but is readily decomposed by many of the



Streamlining SAVES PRECIOUS FUEL

STREAMLINE the flow of gases across the boiler tubes and you get more steam from less fuel. That is what Enco Baffles do. They use scientifically curved baffle surfaces instead of sharp angles. They taper the passes to maintain velocity as the gases decrease in volume, which promotes heat-transfer. They:

- Eliminate bottle-necks
- Abolish dead gas pockets
- Reduce draft losses
- Speed heat transfer
- Keep heating surfaces cleaner
- Cut down use of soot blower
- Provide for tube expansion and replacement

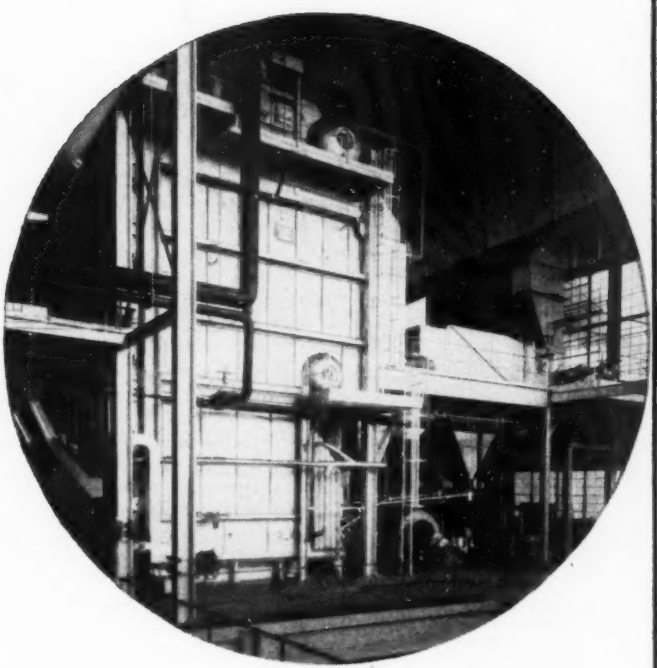
Adaptable to any type of water-tube boiler, fired with any fuel. Designed for each individual installation. Only selected materials used. Installed by skilled mechanics. Send for Bulletin BW 44.

THE ENGINEER COMPANY
75 West Street, New York 6, N. Y.

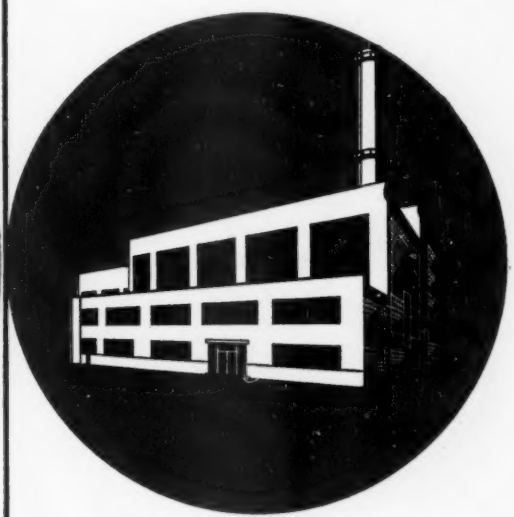
Enco
Streamline
Baffles
Produced exclusively by The Engineer Co.

City of Manitowoc installs fifth WICKES steam generator

To provide a dependable source of power for the City of Manitowoc, Wisconsin, the Manitowoc Public Utilities Commission has just installed a fifth WICKES Steam Generator capable of producing 175,000 lbs. of steam per hour at 525 psi. Final steam temperature is 750°F. The new WICKES Boiler has 11,600 sq. ft. of heating surface. It is equipped with an economizer and fired by spreader stoker.



R. E. Cannard — Chief Engineer and General Manager



WICKES can fill your requirements for all types of multiple drum boilers generating up to 250,000 lbs. steam per hour at pressures up to 1000 psi. adaptable to any standard method of firing — oil, gas, single retort underfeed or spreader stoker. For pressures up to 900 psi. with sustained steam production up to 35,000 lbs. WICKES Type A Boilers can be shop assembled, ready for immediate installation. Write today for descriptive literature or consult your nearest WICKES representative.

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DIVISION OF THE WICKES CORPORATION

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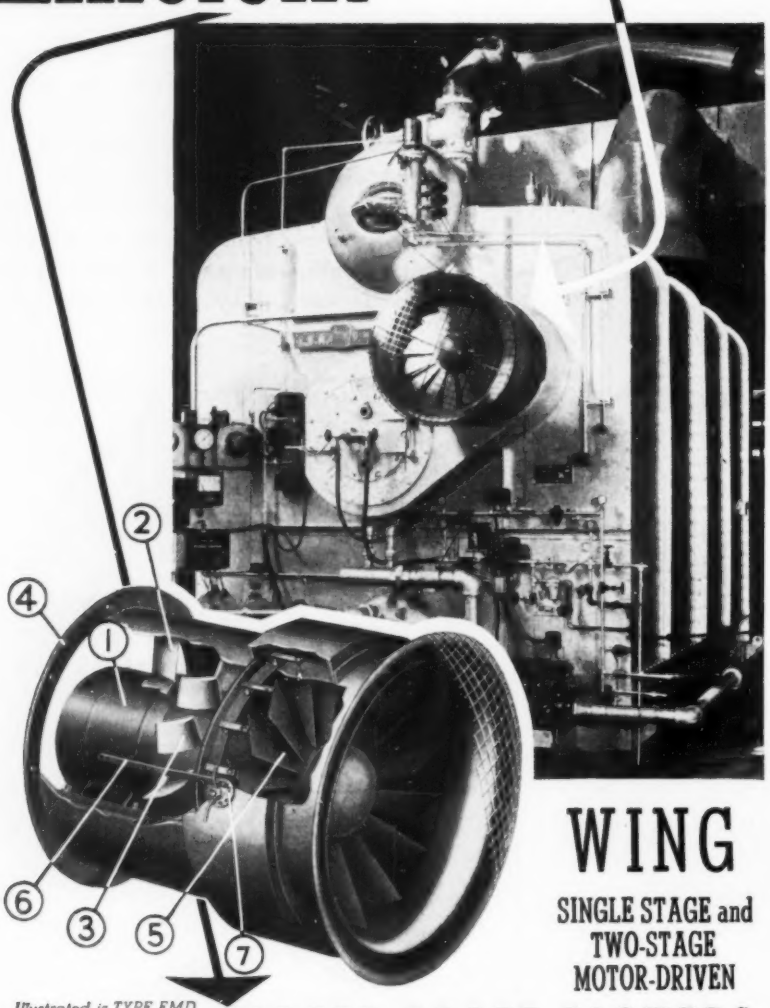
150

Efficient



WING

SINGLE STAGE and TWO-STAGE MOTOR-DRIVEN

FORCED DRAFT BLOWERS

Illustrated is TYPE EMD Single Stage Blower (1) Fully enclosed motor. (2) Air straightening vanes. (3) Axial flow airfoil fan wheel mounted directly on motorshaft. (4) Blower mounted at this flange—no other support needed. (5) Voltrol Vanes. (6) Lever for capacity regulation. (7) Voltrol vane control mechanism.

WING Motor-Driven, Forced Draft Blowers are the result of years of pioneering with the airfoil design of the axial-flow fan. Each part of the Wing Blower is made to produce and control the air flow into the furnace for *maximum* firing efficiency. Sturdy construction, compact design, quiet performance, Voltrol Vanes, (permitting capacity regulation down to 10% of max.) plus low installation cost—are features of Wing Motor-Driven Blowers. Write for Bulletin SW-1a.

Wing

L. J. Wing Mfg. Co.

50 Vreeland Mills Road
Linden, New Jersey

Factories: Linden, N.J. and Montreal, Can.

RECIRCULATING WATER

Continued from page 202

microorganisms. White fungi are selective in their attack on cellulose or lignin; only a small minority prefer the lignin. Fungi will attack pure cellulose, but even those that destroy lignin in wood will not attack isolated lignin. So lignin apparently protects the cellulose from decay.

Because fungi are efficient in utilization of nitrogen and other minerals there is some question about the effect of phosphate in water treatment. Activity is affected by pH.

Alkaline salts seem to favor decomposition, possibly because organic acids formed by the fungi are neutralized Some fungi are sensitive to tannin and other extractives in wood. The nondurable woods—black locust, cedar, cypress, redwood—are rich in volatile oils that are toxic to fungi.

Vacuum Deaeration. Because of constant reaeration, water recirculated through cooling towers is aggressive to metal. Deaeration is one way of inhibiting corrosion where a controlled scale or a film, using chromate, phosphates, or similar salts, cannot be laid down. In such a system, circulating water, after passing through the cooling towers or ponds, is deaerated under vacuum. Biggest objection is cost.

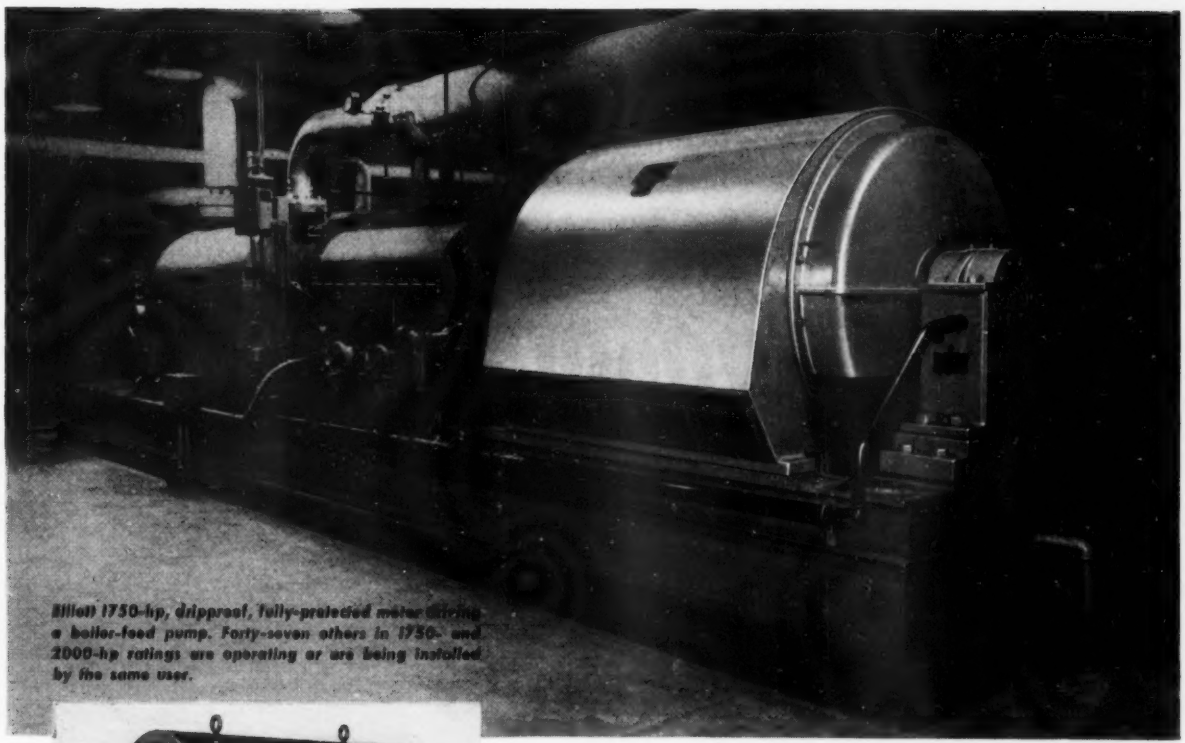
Combined Inhibitors. Most widely used dual treatment to date involves metaphosphates and organic chromates. Metaphosphates by themselves are most effective at pH of about 6.0. Two investigators recently reported on a "dianodic" treatment using sodium chromate and a molecularly dehydrated phosphate. Each inhibitor was effective, but the combination was beneficial to iron and copper alloys at much lower concentrations.

Wetting agents help in penetrating the scale, corrosion products or other materials, preventing contact between dissolved inhibitor and the metal.

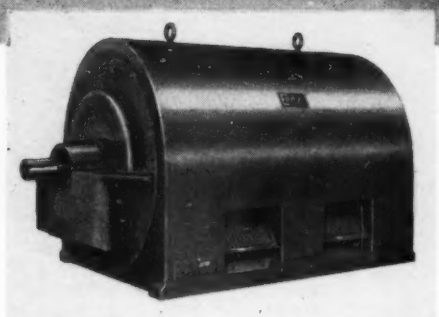
Allowable Solids. In cooling towers, permissible concentrations of salts, soluble and insoluble, depend on type of service of cooling water, design of heat-exchange equipment, as well as other factors.

Curves, Fig. 11, 12, p 89, are convenient for deciding the amount of blowdown needed for different cooling-tower operations.

Oil. Where condensate is not to be used in a boiler cycle or for similar duty where oil would contaminate the service, an oil film is an excellent protection against corrosion. But if water in the lines is recirculated through cooling towers, the oil, will, in time, saturate the wood and create a fire hazard.



Elliott 1750-hp, dripproof, fully-protected motor driving a boiler-feed pump. Forty-seven others in 1750- and 2000-hp ratings are operating or are being installed by the same user.



Elliott two-pole induction motors, 350-4000 hp, are also available with bracket-type bearing construction.

This top air discharge design illustrates the flexibility of Elliott two-pole motor design.

Elliott FABRI-STEEL MOTORS AND GENERATORS

48 large two-pole

ELLIOTT MOTORS

for one user!

When one power generating system purchased 48 of these large, two-pole motors to drive boiler-feed pumps, it was another case of demonstrated confidence in Elliott motor design and construction.

These motors have proven themselves with their exceptionally high efficiency and power factor. With their Fabri-Steel construction, the frame members are joined by the latest welding techniques. This results in high strength and rigidity with light weight. The rigid welded stator frame and bearing bracket construction reduce vibration and noise and maintain uniform air gap. Every motor element reflects this careful engineering and workmanship. Get all the facts in Bulletin PB 7000-1-151. Write Elliott Company, Ridgway, Pa.

ELLIOTT Company

R3-23

RIDGWAY DIVISION

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.

Foster Reducing Valves, Relief Valves, Vacuum Breakers and Liquid Level Valves are available in all-stainless construction to resist corrosion and avoid contamination.

All valve parts in contact with fluids may be had in a wide range of corrosion resisting alloys.

For corrosion resistant, non-contaminating service, plus the usual Foster dependability and maintenance-free performance, it will pay you to tell your Foster Representative your requirements.

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PRESSURE REGULATORS • RELIEF AND BACK PRESSURE VALVES • CUSHION CHECK VALVES • FAN ENGINE REGULATORS • PUMP GOVERNORS • TEMPERATURE REGULATORS • FLOAT AND LEVER BALANCED VALVES • NON-RETURN VALVES • VACUUM REGULATORS OR BREAKERS • STRAINERS • SIRENS • SAFETY VALVES • FLOW TUBES

FOSTER ENGINEERING COMPANY · UNION, N. J.

More PLANT PROBLEMS

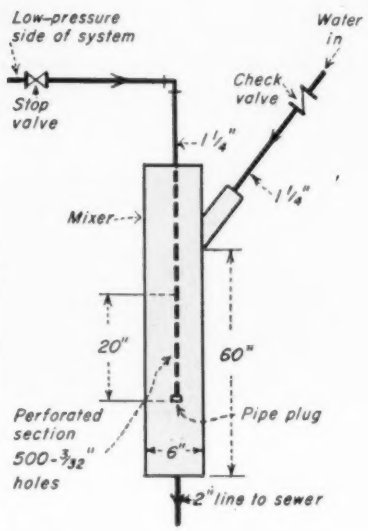
Continued from page 134

prevent backflow from the waste line. Fit tank with a vent discharging outdoors.

Lower sketch, p 134, shows tank with two sets of spray nozzles. Upper set discharges water downwards, lower set discharges ammonia upwards. The water absorbs the ammonia gas when the two streams meet in the tank.

Size inlet and outlet pipes on tank so the required water level is maintained. Check with local authorities to see if disposal of an ammonia-water solution into a public waste system is permissible. If not, it will be necessary to neutralize the solution to meet health and sanitation requirements.

H B WAYNE *Brooklyn, N. Y.*



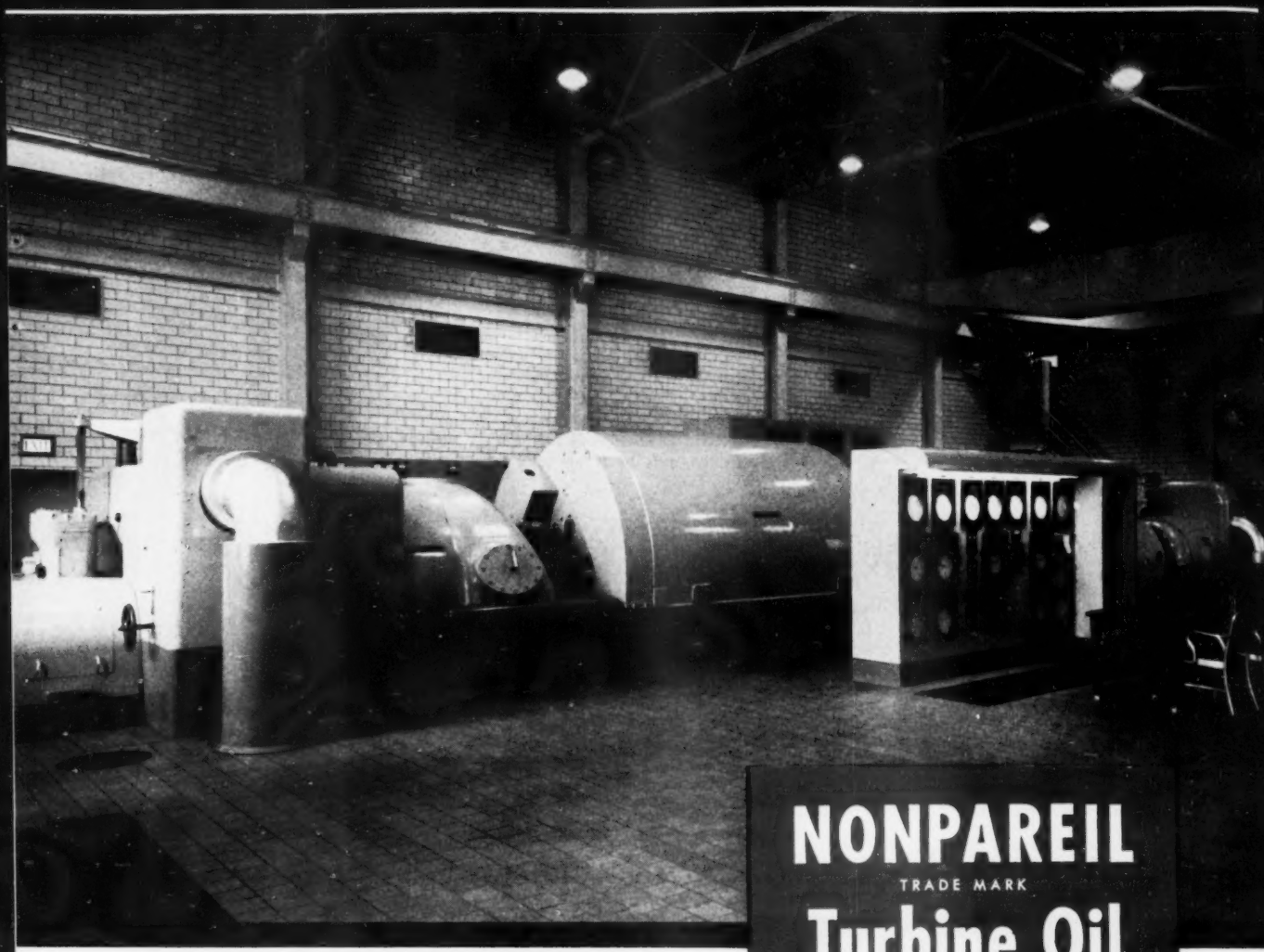
USE A MIXER to prepare the ammonia-water solution. Connect to low-pressure side of refrigeration system, and to the water supply and sewer. Entire charge can then be mixed with water and discharged to sewer.

Sketch shows a typical mixer and the dimensions of various parts for a system containing 2000 lb of ammonia. Check to see if there are any laws in your area governing the installation and construction of such devices.

H A KAISER *Glendale, N. Y.*

REMEMBER, liquid ammonia must be dumped, not vented as a gas. To vaporize the ton of ammonia *TS* has in his plant, about 1.2 million Btu are required. He cannot supply heat to his system that quickly.

Gas pressure in system can be used to force liquid ammonia to water tank but if a broken line is expected, he must use a pump for this job. Ammonia is so soluble it dissolves completely if



NONPAREIL
TRADE MARK
Turbine Oil

Nothing succeeds like service!

● This turbine, one of the largest industrial units in the Midwest, was recently installed by a leading paper mill. The decision of mill officials to lubricate the new turbine with NONPAREIL Turbine Oil was based on their own experience with this outstanding product.

Beginning in 1941 in one unit, NONPAREIL has since been put into additional turbines; and, today, it lubricates all turbines in this big mill. Over the period of 12 years, it has not been necessary to replace any of the original fills of NONPAREIL because of lubricant deterioration or lubrication trouble. Oil systems have stayed clean. Oil acidity has stayed below 0.07 mg. KOH/gm.

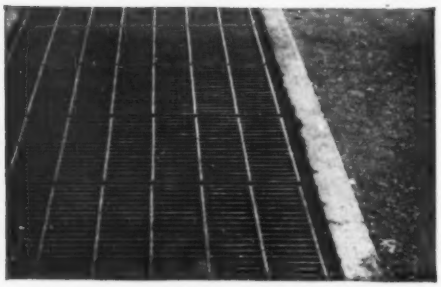
In this mill, as in power plants throughout the Midwest, NONPAREIL has sold itself into one turbine after another. That success has been the result of superior turbine lubrication service. Service records of NONPAREIL cover up to 25 years' continuous operation of individual units on original fills of oil. Moreover, this unique lubricant carries a written guarantee that it will last as long as the turbine it lubricates and that its neutralization number will stay below 0.15 mg. KOH/gm.

The Standard Oil lubrication specialist serving your section of the Midwest will be glad to show you lubrication records of NONPAREIL in installations similar to your own. You can contact this specialist by phoning your local Standard Oil office. Or, write: Standard Oil Company (Ind.), 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD OIL COMPANY

STANDARD (Indiana)

Hendrick Heavy-duty Grating...



has wide range of usefulness

withstands weight of heaviest trucking, inside or outside of industrial plants . . . excellent for drainage applications... for coal grizzlies . . . and wherever it is necessary to sustain unusually heavy loading.

In prominent steel casting plant, Hendrick heavy-duty grating used for breakout floors has paid for itself many times over in reclaimed sand.

Bearing bars range in size from 2¼" x ⅜" to 4" x ⅜"; cross bars from 2" x 5/16" to 2½" x 5/16"; to meet requirements of loading conditions. Write for complete specifications.

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Perforated Metals
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ALLPAX

...the Packing that PACKS ALL

Your problem is different?

Of course your problem is different. That's why we suggest you call on ALLPAX to help you . . . to develop a special packing, if necessary, which takes care of *all* the conditions of your specific requirements. If you call on ALLPAX you can safely "pack up your troubles" and be assured of a packing which will cost you less because it will last longer, and is exactly *right* for the job it has to do.

ALLPAX is available in ALL types . . . coil, ring or loose form for temperatures to 600°; specials for higher temperatures.

Also: Valve Discs, Sheet Packing, Retainer Packing, Molded and Mandrel Cut Packing Rings, Packing Hooks and Gasket Cutters.

Contact your nearest distributor.

Ask for complete catalog.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.
Superheat Sheet Packing . . . Oil Proof Sheet Packing
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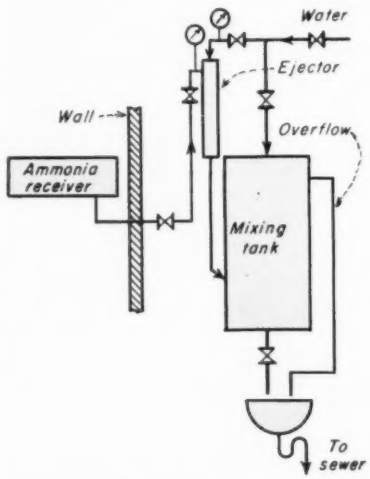
Packing . . . Cloth Inserted Sheet Packing

More PLANT PROBLEMS

Continued from page 206

released at tank bottom through a sparger tube. Base pipe sizes on distance between ammonia receiver and water-storage tank, and flow of water and ammonia required. This also applies to the distribution of holes in the sparger tube.

K A KOBE *Austin, Tex.*



PREVENT FREEZE-UP by using enough water to absorb the ammonia. Locate mixing tank in a room separate from the ammonia receiver. Use gages to adjust ammonia-water proportions in the ejector on mixing tank, sketch.

Don't run drain and overflow direct to sewer; use a bowl as shown. Water supply may come from city main, fire pump, or any other source of cool water under pressure. With a 500-gal mixing tank the whole ammonia charge could be dumped in a few minutes.

Tank may be full or empty at start of disposal but, if full, size of sewer limits the disposal rate. If tank is empty, ammonia drain valve can be opened wide at the start and adjusted as the tank fills.

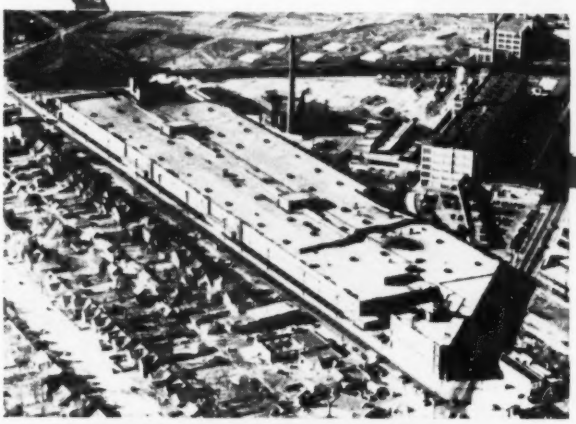
Vent tank to outdoors. Pipe the ammonia-water mixture into the tank at an angle so mixing will be better. I don't think *TS* needs baffles in the tank. A check valve is needed in the liquid-ammonia line to prevent water entering the system. Use steel or wrought-iron fittings.

JAMES SMITHWICK *Washington, D. C.*

COMMERCIAL MIXERS are available for disposing of ammonia in a hurry. During World War II we rigged a mixer to handle 3500 lb of ammonia. Two solenoid valves, one for ammonia and the other for water, allowed us to control disposal from a remote location. We also hooked up compressor so we

7 DETROIT STOKERS

in two *Eli Lilly and Company plants*

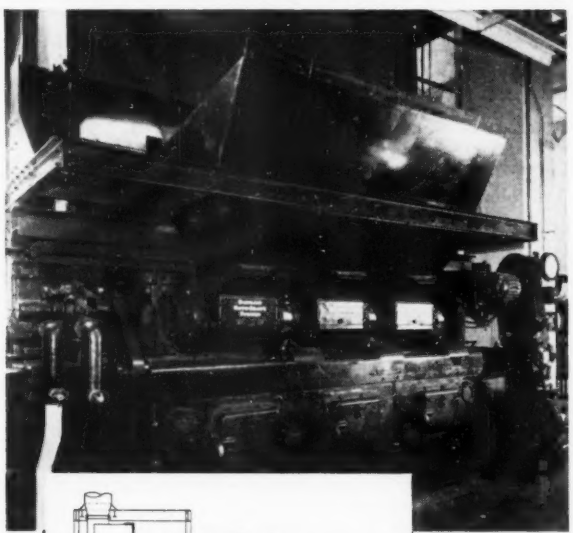


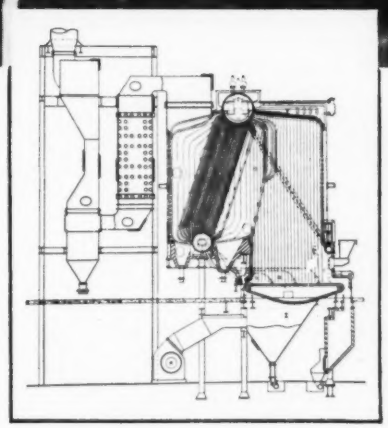
FOUR CONTRACTS

High efficiency with low maintenance—ability to handle rapidly fluctuating loads, and cleanliness are Detroit Stoker features that appealed to Eli Lilly and Company engineers.

Cleanliness—elimination of sources of possible contamination—is of paramount importance to plants making thousands of medicinal products having the highest reputation for purity.

At the left one of the two Detroit RotoGrate Stokers at the Lilly Indianapolis plant. Capacity each Babcock and Wilcox unit 75,000 pounds per hour. RotoGrates also are in service at their new Tippecanoe Laboratories, Lafayette, Indiana.





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DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

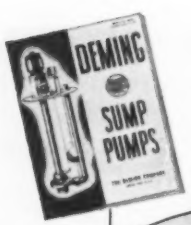
District offices in Principal Cities • Works in Monroe, Mich.

(DEMING PUMP SPEAKING)

"I work in a knitting mill. My job is to recirculate a corrosive liquid bleach through a tank with heating coils. The hot solution is then sprayed into vats which hold about 3000 lbs. of unbleached cloth. I pump for about 9 hours at a stretch. Then I rest for about 1½ hours while they unload the bleached cloth from the vats. Then I start pumping on my next 9 hours' stretch.

"I've been on this job for 1½ years with no layoff due to me. My boss hasn't spent a nickel for repairs or maintenance on my account. He says that the pumps I replaced on this job cost him plenty in upkeep. They were run by V-belts which would rot out and the pump bearings would corrode and freeze. Other troubles included the loss of many a batch of ruined cloth. So he tells me I cured a lot of headaches and reduced a lot of costs."

(The Deming Pump speaking is a standard Fig. 4612 with regular drip proof motor. Full details on request.)



Send for BULLETIN NO. 4600-A

This illustrated bulletin gives you plenty of facts on the latest models of Deming Sump Pumps.

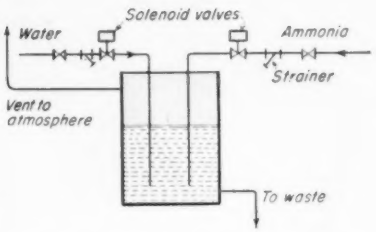
THE DEMING COMPANY

547 Broadway • Salem, Ohio, U. S. A.

Specify DEMING PUMPS

More PLANT PROBLEMS

Continued from page 208



could stop it immediately, if necessary.

We built several control stations, at different locations in the plant. Each was fitted with two colored pilot lights and a horn to warn personnel of danger to the refrigerating system.

Don't use solenoid valves if you wish to have manual control over the mixing process. Build a separate tank where you can mix the ammonia and water. Discharging ammonia to the main water tank will pollute it at a time when water may be needed for other purposes. Sketch shows solenoid valves.

CARL BACHMAN *Rego Park, N. Y.*

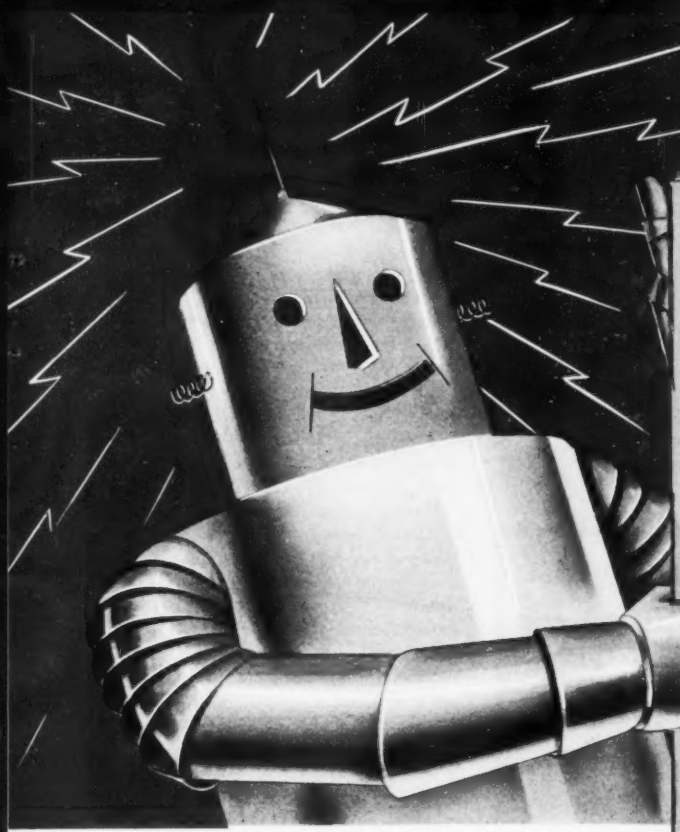
PUMPS

Continued from page 113

or zero discharge position. These pumps are built for capacities of 3 to 340 gpm with supercharged intake pressure, and for maximum discharge pressures up to 3000 psi. Hydraulic motors are built on the same principle as the pump, either as single units, or as a single assembly by combining the pump and motor into variable-speed drives.

Wobbler Plate. Fig. 4 shows a variable-displacement, horizontal piston pump of a wobbler-plate type where the wobbler does not rotate. It has a constant-displacement rotary pump *R*, whose rotor is keyed to the drive shaft. This shaft, supported in two ball bearings *B*, has on its end an angle socket *S*, the horizontal axis of which is on the shaft axis. Suction and discharge valves are in valve-plate *V*. To the left of valve-plate *V* is the variable-displacement pump with five pistons *P* held in contact with wobbler plate *W* by fluid feed from rotary pump *R*. Wobbler plate connects by a shank to ball-bearing *C* in socket *S* at the drive-shaft end. A ball on the end of plunger *D* fits into a socket in the wobbler plate to support the latter and leave it free to wobble. When drive shaft rotates the left end of socket *S*, bearing *C* describes a circle with it. This action causes plate *W* to wobble and actuate pistons *P*.

When drive shaft makes half a revolution, its socket moves from a position pointing upward, to downward, and the



AUTOMATIC

Demineralization and Silica Removal by Ion Exchange Resins

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Effluents of Permutit Demineralizers have contained *total* electrolytes as low as 0.01 ppm and silica as low as 0.01 ppm! These values may be slightly higher under service conditions. In comparison, most distilled water contains 20 to 100 times more electrolytes . . . yet costs much more to produce.

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You'll want this interesting book. Flow diagrams, illustrations and specifications explain key methods of demineralizing water and removing silica by ion exchange. Write for your copy, today!

THE PERMUTIT COMPANY, Dept. P-9, 330 West 42nd Street, New York 36, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal, P. Q.

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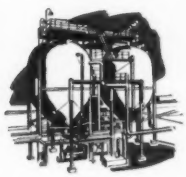

Sludge Blanket Hot Lime Soda

Full utilization of Permutit sludge-blanket principle assures high efficiency. Reduces hardness to region of 20 ppm . . . silica to 2.0 ppm. Lowers alkalinity . . . removes wide variety of solids.

Hot Zeolite—Permutit Q

Permutit Q—a styrene base resin resistant to high temperatures and pH values—replaces second stage phosphate treatment in hot-process softener. Results—residual hardness is completely removed at great savings in phosphate costs.

Deaerating Heater

Removes objectionable oxygen and CO_2 to prevent corrosion and pitting of feed lines, stage heaters, economizers, and boilers at high temperatures. Steam is used twice . . . deaerates water completely.

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Softens water on space and time-saving sludge-blanket principle. Simultaneously removes turbidity, color, fluorides, reduces silica and lowers alkalinity.

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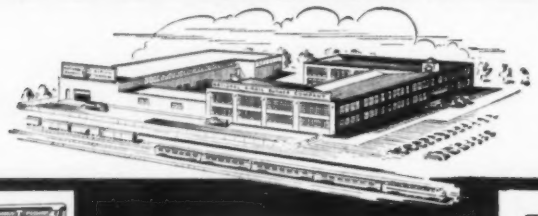

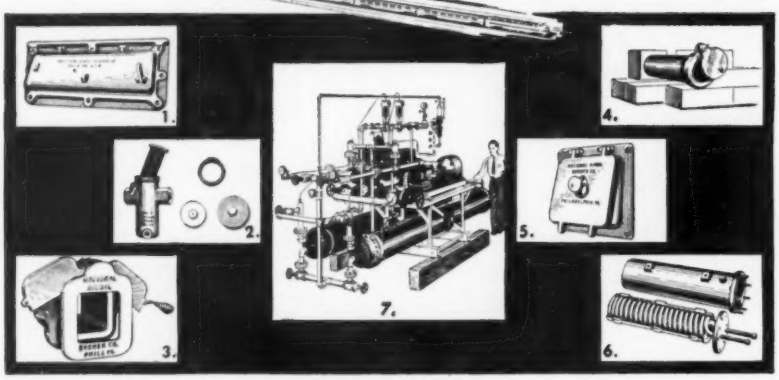

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May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

PUMPS

Continued from page 210

horizontal axis of bearing *C* moves to below that of the drive shaft. During this time the top half of the wobble plate moves to the right and pushes top piston to full discharge; bottom piston moves out to full suction. When drive shaft completes a revolution, wobble plate and pistons return to position shown, having completed a full suction and discharge stroke. While these two pistons were going through their cycle of suction and discharge, the other three were doing the same.

Stroke Length. With bearing *C* in position shown, wobble plate and pistons have maximum motion and the pump full capacity. If plunger *D* is moved to the right, it forces wobble plate toward a vertical position and bearing *C* downward in socket *S*. When wobble plate is vertical its shank will be horizontal and its axis with that of bearing *C* will be on drive-shaft axis.

Now, when drive shaft rotates, its socket turns around bearing *C* without moving wobble plate; motion of pistons *P* is reduced to zero. Moving wobble plate, from position shown to vertical, adjusts pump output from maximum to zero. Position of wobble plate and piston stroke can be adjusted manually or automatically. Ratings of these pumps range from 0.5 to 2 gpm at pressures up to 1000 psi when operating at a normal speed of 1140 rpm.

CHEMICAL PLANT

Continued from page 100

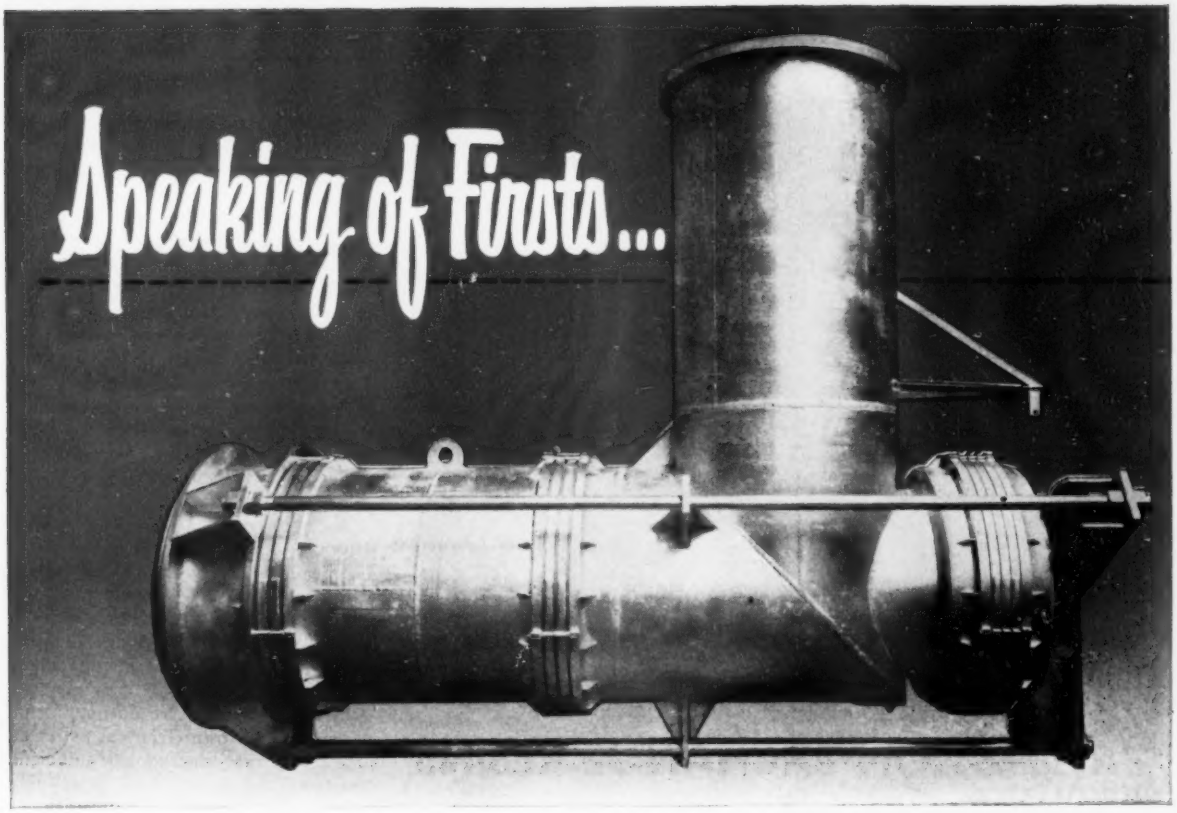
be doubled with additional, properly spaced wells, without lowering this table.

A float switch controls the pumps and automatically cuts them in rotating sequence so supply is evenly distributed between the wells. One pump has a gasoline engine plus a motor drive. All others are deepwell turbine type with motor drives.

Additional fire protection comes from a 300,000-gal ground-storage tank, connected to a 1500-gpm motor-driven fire pump that automatically cuts in when the hydrant pressure drops.

Feedwater for the boilers is drawn from this plant raw-water supply. It tests out at 6 to 16 ppm, total hardness, with a pH of 5.1 to 6.7, and a silica concentration of 7 ppm.

Our chemical treatment per 1000 gal of makeup water consists of (1) 0.22 lb of an organic colloid—a blend of anhydrous organic and inorganic chemicals furnished under a trade name (2) 0.1 lb of anhydrous sulfite to prevent corrosion and pitting from dissolved oxy-



Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

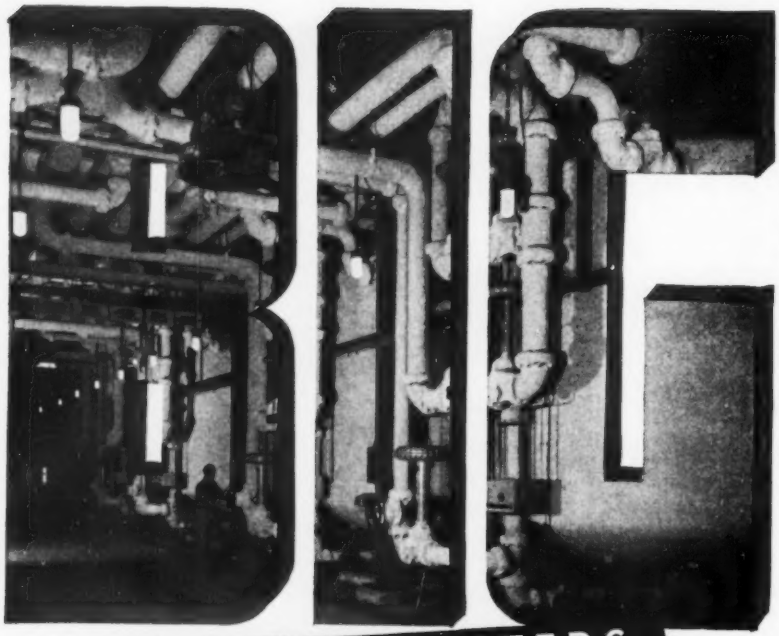
This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS



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(DOWEX*)

THIS demineralizer, one of the world's largest, provides 100% makeup for 1250 psi boilers generating 1,200,000 pounds of steam per hour. Using Nalco ion exchange resins, Nalcite HCR® and Nalcite SAR, silica is successfully removed from the feedwater — as illustrated by the fact that after 75 to 100 concentrations, silica content of the boiler water is still *less than 5 ppm!*

In demineralizers large or small, Nalcite ion exchange resins give top performance. They are chemically and physically stable for long life at top efficiency. *Two* Nalcite anion exchangers . . . your choice of SAR or SBR . . . are available to meet the conditions of your water supply. Either, used with Nalcite HCR, offers top quality demineralized makeup for high pressure steam generators.

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DATA ON SILICA REMOVAL

A new edition of Nalco Bulletin 57 gives technical data on Nalcite SAR and Nalcite SBR anion exchangers . . . includes complete up-to-the-minute information on silica removal. Write for your copy today.

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CHEMICAL PLANT

Continued from page 212

gen (3) 0.09 lb of caustic soda. These chemicals enter the makeup water or boiler through feed pumps, controlled by panel adjustments, to assure proper feed ratios.

The feedwater passes through continuous blowdown heat exchangers in a vertical, spray-type deaerating heater, 120,000-lb capacity, operating at 10-psi steam pressure. This deaerating heater reduces dissolved oxygen content to 0.005 ml per liter. Steam for the deaerator comes from the exhaust line of steam-driven boiler auxiliaries and a steam-driven air compressor. Additional makeup steam is available through a desuperheater and reducing station at 10 psi.

Then three 60,000-lb-per-hr steam-driven 4-stage centrifugal boiler feedwater pumps deliver water to the boilers at 200-psi pressure. (Two additional impellers can go in at a later date to develop the necessary 600-psi delivery pressure when the plant goes to high-pressure operation.)

Electrical Energy. We do not intend to generate our own electrical power at present. Power-generating equipment investment for our present load outweighs the savings it could return. Later, maybe in four or five years, the load may justify power generations. This is one reason why we selected boilers capable of 600-psi steam generation.

Right now we get our electrical energy from the local utility through two sets of power-transmission lines that enter a 3000-kva, 33/2.4-kv, outdoor transformer station. This substation can be doubled in capacity at a later date. A brick switchgear house contains the meters and circuit breakers for the main circuits. These circuits—each separate—feed the steam plant, water-supply pumps, the three principal manufacturing buildings, the machine shop and auxiliary buildings, and the sewage-treatment plant.

Power-distribution poles outside the plant perimeter carry the 2400-v lines from the switchgear house to the point of connection with underground conduits leading to 2400/440-v transformers, close to the individual service loads. All motors are 440-v except the water supply units which, because of their remote locations, were selected for 2400-v operation.

A copper circuit grid, connected to the deepwell-pump casings, circles the plant and serves as a zero-resistance ground for all equipment and structures. We went to this grounding device when our tests indicated the sandy soil had too high a resistance for proper grounding protection.

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BLOWOFF VALVES

Continued from page 97

But a number of tests show that at present it is usually necessary to use the boiler's manual blowdown valves during the period immediately following the first light-off of fires for the quick start. On the boilers tested by one utility the continuous-blowdown lines sometimes do not have sufficient capacity to keep water-level surge within desirable limits during the first few minutes after starting. But when the manual valves are used in conjunction with the continuous system, drum-water level is easily and accurately controlled.

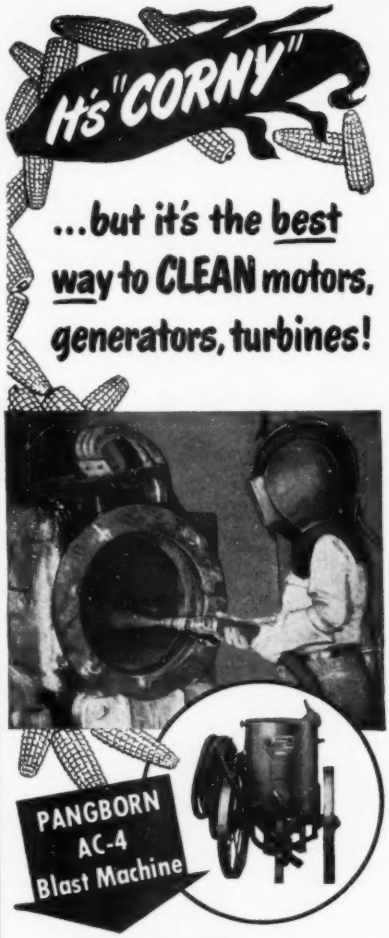
It is interesting to note that in several plants today blowdown operations are guided by the water-level indication on a television screen in the control room. Studies show that drum-water level needs constant attention during quick starts.

Specifications, accurately written, insure that valve manufacturer delivers exactly what you want for the boiler. The surest way of tying down the valve you desire is by using its name and figure number as given in the manufacturer's catalog, plus the size and number of valves desired. It is also advisable in every blowoff-valve spec to add a phrase stating that valve is to conform to ASME Boiler Code, or other applicable code if there is one. Include in the spec the maximum working steam pressure the valve must withstand.

Where valve name and figure number cannot be mentioned in spec, give a complete description of the valve and its trim material. If acid washing is contemplated, be sure to state this in the specification for the valve. Since two valves are required for blowoff service, a specification is needed for each one. These specifications should be complete for each valve.

Valve Installation. Ease of operation and space limitations are the two determining factors in blowoff-valve installation. So be sure to check plant drawings before deciding which arrangement of valves is most suitable. Remember, plant operators are just as human as the rest of us. Locating a valve in an area that is relatively inaccessible or installing it so handwheels are difficult to reach just makes the operator's job that much harder. He's less likely to follow correct procedures or spend the right amount of time doing the job.

So keep blowoff valves in the open where they are easily seen and reached. If possible, run piping to and from the valve in such a way that operator does not have to reach across it to open or close valve. Fig. 6, 7 and 8 show several



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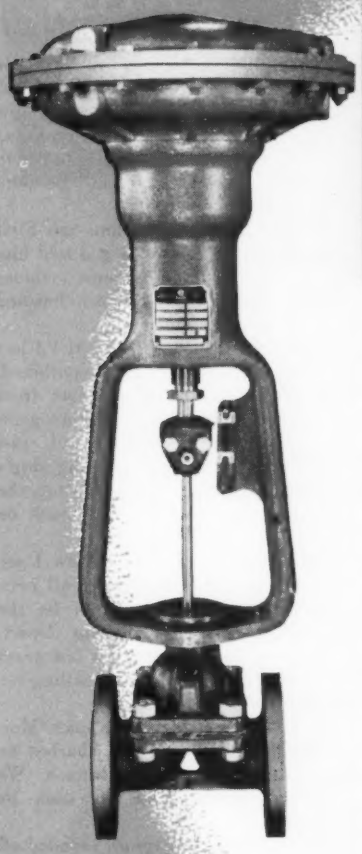

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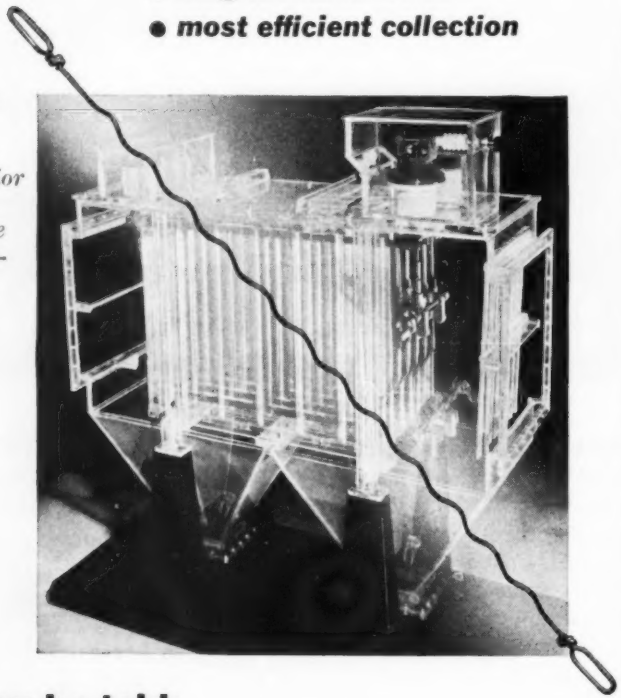

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DUST COLLECTION SYSTEMS

MARMADUKE

Continued from page 140

"The evening before reaching Havana, he told me he'd send a complete report to the home office after I found out what was in the engine. I thanked him for being so *helpful* and mentioned that he was the only captain who'd ever taken enough *interest* in my department to go to all that trouble.

"'You've got the makings of a good engineer,' I soft soaped him, 'Why don't you come below when we open the engine. I'm sure you can give me some good technical advice. My boys would probably take the whole engine apart before they'd think of looking for that noise in a cylinder.'

"That swelled his head plenty. He started to spout like a sperm whale off the coast of Labrador. 'I've been giving advice to all my chief engineers,' he boasted, 'but you're the first one with brains enough to listen to me.' Boy, did he swallow that bait.

"After dinner I went into the First Assistant Engineer's room and told him to open up the high-pressure cylinder soon as the old man rang down 'finished with engine' next morning.

"The First looked at me as if I'd lost my rudder. 'Now listen,' I continued, 'Run the piston up about a foot from top dead center with the jacking gear. Then raise the cylinder head just enough so you can ease the big ship's anvil onto the piston. Then drop the head down and put the nuts back on hand tight.'

"The First got the idea. 'Now I see your scheme,' he said. 'We've all been wondering from the way you let the skipper poke his nose into our department if you hadn't stripped a few gears yourself. But I guess you're sailing before the wind after all.'

"Next morning we sailed past Morrow Castle and into Havana harbor on time, just as the captain predicted. We were tied up alongside the dock by 6:30 am.

"At breakfast the captain sounded off as usual. Now that I seemed glad to have his advice, he wanted to know when I'd open the main engine. At this point the First Assistant piped up and said he had given his men instructions to have all the tools ready so the h-p cylinder-head could be lifted right after breakfast.

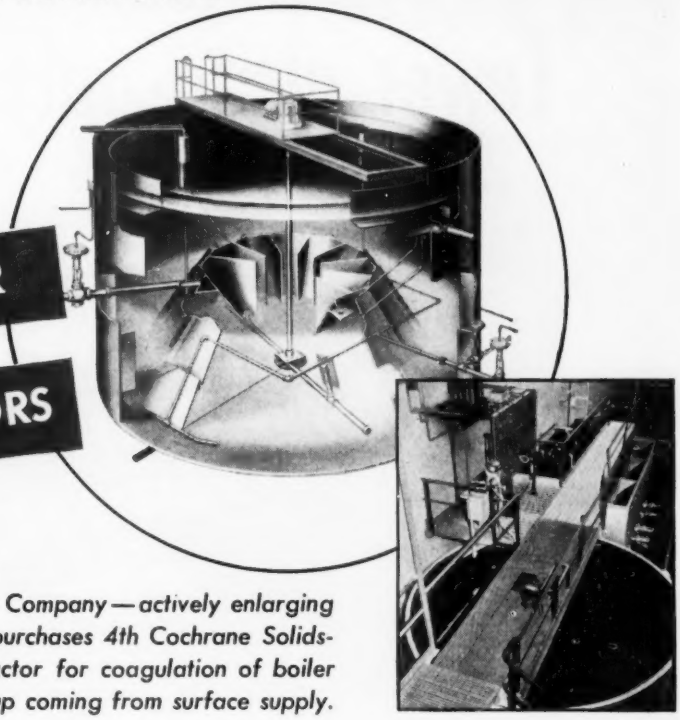
"'Good,' said the skipper, 'I'll be there.'

"Soon as we finished eating, the captain and I walked up to the boat deck. I told him he could look down the skylight because it was too hot to hang around below. My boys were already removing the nuts from the 2-inch studs when Westwood peered below.

(*Continued on page 220*)

COCHRANE WATER CONDITIONING
STARTS WHERE NATURE STOPS

REPEAT ORDERS FOR COCHRANE REACTORS



Duke Power Company — actively enlarging capacity — purchases 4th Cochrane Solids-Contact Reactor for coagulation of boiler feed make-up coming from surface supply.

● This record of repeat orders is evidence of successful design and performance. Units are being built for coagulation, lime softening, iron removal, fluoride removal, white water recovery in paper mills, cooling water treatment, process water clarification, tin plate rinse water, oil field flooding water and similar applications.

They can be built in small sizes—such as for the bottling trade, or in very large sizes—such as for paper mills, up to 110′0″ dia., capable of handling more than 20,000,000 GPD in a single unit.

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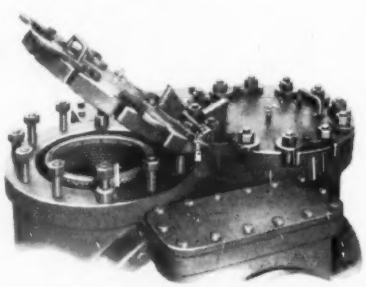
DOORS ARE OF HEAVY STEEL PLATE, crack-proof even under most unusual stress. No need to worry when turning down the holding nuts to insure uniform stress all around. The nuts are never removed from the studs as backing them off a turn or two relieves tension on the "S" shaped washers, which can then be slipped aside to permit raising of the door.

Elliott Twin Strainers are used in practically every industry where liquids are involved. Types for high and low pressure. Sizes 4 in. to 24 in. Bulletin A-13 has complete data. Ask your local Elliott representative or write Elliott Company, Jeannette, Pa.



ELLIOTT Company

Accessories Dept.

A3-1

MARMADUKE

Continued from page 218

"Finally the nuts were all removed and the third assistant started heaving away on the chain fall. The skipper was so interested he kept his eyes glued below.

"'I'll bet it's a mighty big wrench they left in there that's been making so much noise,' he muttered.

"'I wouldn't be surprised if it even turned out to be a sledge hammer,' I agreed.

"Finally the head was hoisted and the boys started moving it over the intermediate pressure cylinder. I couldn't bear to look below, so I glanced up at the stack instead.

"All of a sudden the old man's eyes popped out of their socket and he started turning pink around the gills, as if about to pop his rivets. He waved his arms wildly, pointing down below, 'HOLY SEA COW!' he yelled excitedly. 'LOOK! LOOK BELOW CHIEF—IT'S THE ANVIL YOU'VE BEEN LOOKING FOR!'

"I looked and then acted plenty surprised.

"'I told you something was in the engine,' he roared excitedly. 'Just wait until this report gets to the home office.' With that he took off for his office like a flying fish.

"Down below my boys removed the anvil—after they stopped laughing—and closed up the engine. Then they removed a few shims from the h-p crosshead brasses and keyed her up. And sure enough, between Havana and Nassau, that 2500 hp engine was as quiet as a sewing machine. To the skipper, that was positive proof that it was the anvil that had made the engine knock.

"When we finally got back to New York a few weeks later, Captain Westwood was amazed to find himself relieved of his duties as master of the *S S Munargo*. Why? Well, the port engineer told me afterward that when the home office got that screwy report about the anvil, the president, who had been a ship's captain himself, raised plenty of hell. When he read that cockeyed report, he let go a blast.

"'Westwood has finally split a seam,' he roared, and the port engineer agreed. 'Why even a dumb oiler knows there isn't enough clearance for an anvil between that 22-inch diameter piston and the cylinder head.'

"'He's already made a nervous wreck out of one chief,' put in the port engineer, 'and now he imagines he sees anvils in the main engines. Either he's hitting the bottle or he's flipped his lid—and chances are it's both.'

"So at last, Captain Westwood's gangplank got a real greasing—by an anvil."

This Mead-Morrison Unloader features a gearless hoist (slow speed motor coupled direct to drum shaft) and variable voltage control.

SPEEDY unloading SIMPLE operation

Typical of Mead-Morrison Rigs

The illustration shows a 6-ton Mead-Morrison coal unloader on the Ohio River . . . one of the many Mead-Morrison rigs that are making records for speedy, economical, dependable operation at steel mills and power plants.

The rapid unloading of river coal barges is further aided by Mead-Morrison barge haul machines. Our engineers will be glad to help you plan your new unloading facilities or give you information for increasing the capacity of your present equipment.

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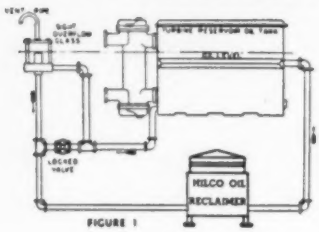


FIGURE 1

• The HILCO system results in removing contamination as fast as it is formed, thus maintaining the oil in first class condition.

• The HILCO OIL RECLAIMER is self-contained, including built-in pumps, electric heaters, starters and controls. It is compact, easy, and quick to service.

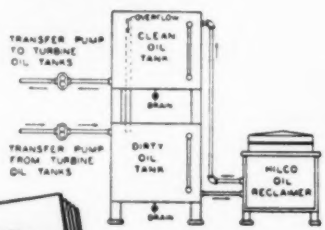


FIGURE 2

FOR MORE INFORMATION ON THE HILCO SYSTEM

More TECHNICAL BRIEFS

Begins on page 148

The experiences discussed have been taken from actual operating records of several different units, both natural and controlled-circulation types. Inasmuch as more than thirty units of different sizes have heating surface arrangement, furnace arrangement and method of firing all of the same general design and have shown the same operating behavior, it may be assumed that this will continue to hold true for the entire size range from 40 mw to 250 mw or larger.

Plant personnel have found these units no more temperamental or difficult to handle than once-through units, Fig 2, page 152. Addition of reheating has not complicated operation or reduced reliability of the steam-generating unit. In fact, no serious difficulties of any sort have been encountered.

Use of controlled-circulation principle does not alter any actual steam-generating characteristics except to provide for assured and uniform distribution of water to saturated steam surfaces of the unit. It also assists in the matter of maintaining uniform water level, even with widely fluctuating loads, and thereby contributes to maintaining high steam purity at all times.

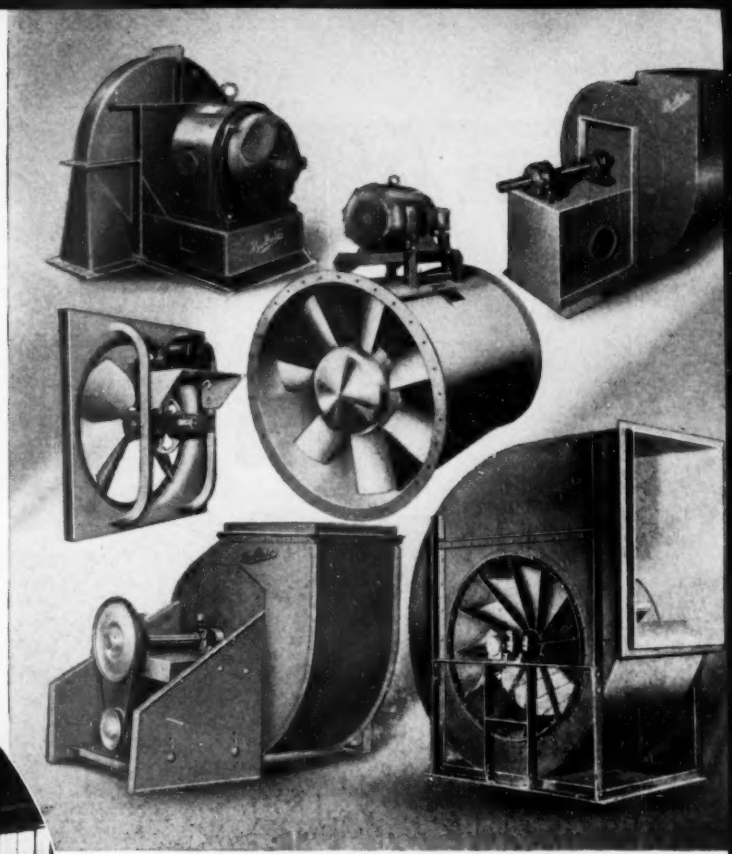
Controlled-circulation is usually indicated when operating pressure reaches a level where the thickness of furnace-wall tubes normally employed for natural-circulation designs has its hot-face temperature stress approach too close to safe allowable limits. The remedy is to employ smaller diameter tubes to reduce thickness resulting in lower stress and larger margin of safety. Smaller diameter tubes, however, increase resistance to flow, and at high pressure the difference in density of water and steam is reduced to a point where very little natural-circulation effect is available. The addition of a means for stimulating circulation and also regulating flow through all circuits is provided by the principle of controlled-circulation. It is also the forerunner of what is coming within the foreseeable future. That is breaking through the critical pressure barrier with the next step around 4500 psi. *APC Paper, no number.*

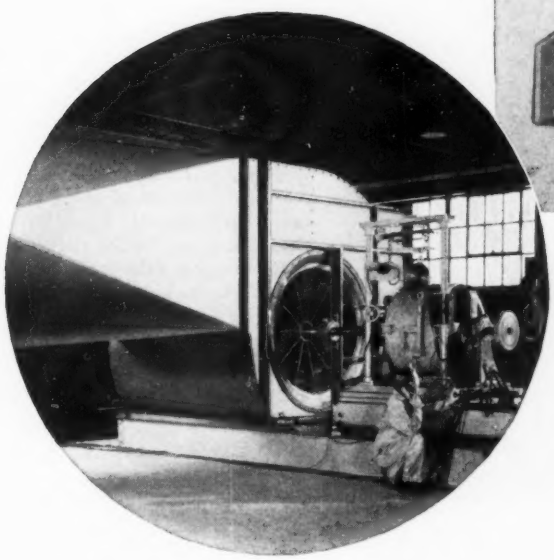
Directions for ordering papers on p 150

Black Liquor—A Paper Mill Fuel. *By John E Hoeft, National Container Corp of Wisconsin.*

As a fuel, kraft black liquor, in comparison with other fuels is very poor. Its heating value as fired is about 4,000 Btu per pound, while Midwestern bituminous coal will run 12,000 Btu per pound. Bunker C fuel oil would run 18,600, and lignite will run around 7,000

MAINTENANCE DIVIDENDS from Proper Fan Selection





In the "Buffalo" Test Room, engineers put fans thru every conceivable performance test. Continual improvement—better performance—lower fan maintenance costs—are the results. In the station at left, thrust, noise, and performance characteristics are checked.

If you keep records of maintenance costs, you'll already know that first cost can be of minor importance on some equipment.

On fans, for example, over a period of years, maintenance costs can be considerable. We believe, after seventy-six years' experience in air handling, that some of this excessive maintenance cost comes from improper selections of equipment.

"Buffalo" manufactures 20 lines of fans and blowers, for every service from residential kitchen ventilation to sub-zero airplane instrument testing—from 20 CFM to 600,000 CFM. We have, in our engineering files, almost every problem which AIR has been asked to solve.

We have the Engineering organization which produced, in 1914, the first edition of "Fan Engineering," ever since, the Bible of the air industry.

We do not hesitate to say, occasionally, "It cannot be done with present equipment."

Why not capitalize on this accumulated experience? Why not get the benefit of the "Q" Factor* that "Buffalo" builds into the fans, air cleaning and conditioning equipment, which our engineering sales representatives, in principal cities are ready to discuss with you? Their advice is impartial. No obligation—and no regrets.

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More TECHNICAL BRIEFS

Begins on page 148

Btu per pound. However, when considering the chemical recovery in addition to the waste heat recovery considerable expenditures can be justified in the installation of recovery units.

Kraft black liquor as fired is very viscous and, because of suspended chemical solids, quite abrasive. At comparable temperatures it is more viscous than No. 6 fuel oil, so it is necessary to keep black liquor hot in order to handle it. Black liquor is usually pumped to the spray burners at from 200 to 230 F. The heating of this liquor is done by direct steam injection, since indirect heat exchangers soon scale up and lose their efficiency.

There are two methods currently being used to burn Kraft black liquor in recovery furnaces.

In one, liquor sprays into the furnace through a spray nozzle with a splash plate that makes a sort of fish tail spray. This pushes the liquid through a figure eight motion that deposits it on the furnace side walls layer upon layer. The heat of combustion of char in the furnace dehydrates this liquor, forming a black ash char. As this char builds up in thickness, it falls from the furnace wall in chunks to the hearth of the furnace where it is burnt.

The second method sprays the liquor into the furnace through one or more sprays that oscillate slightly. These sprays are designed to form large drops which gently rain down counter-currently to combustion gases and fall, dehydrated, on hearth of furnace.

Directions for ordering papers on p 150

The method of spraying on the walls is said to have an advantage of flexibility. That is, liquor with greater variations in solids content can be burnt with a self-sustaining fire. Also by using a very coarse spray and depositing it on the walls as a wet, sticky matter, from which the liquor char falls in chunks, there is less probability of chemical carry-over onto the boiler surface.

The second method has the advantage of not blanketing large areas of the surface wall with char, thus giving a little better heat absorption in the furnace surface. Both methods are being used successfully.

The fuel bed in this recovery furnace is a large mound of the black ash, or char, that is burnt. It is necessary to keep the fuel bed temperatures low in order to minimize the evaporation and sublimation of the sodium salts which would then crystallize out on the cooler boiler surface. The gas temperature over the furnace bed is about 2300 F.

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

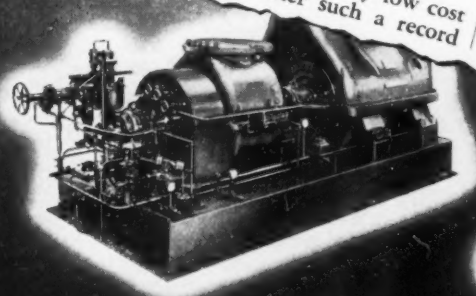
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

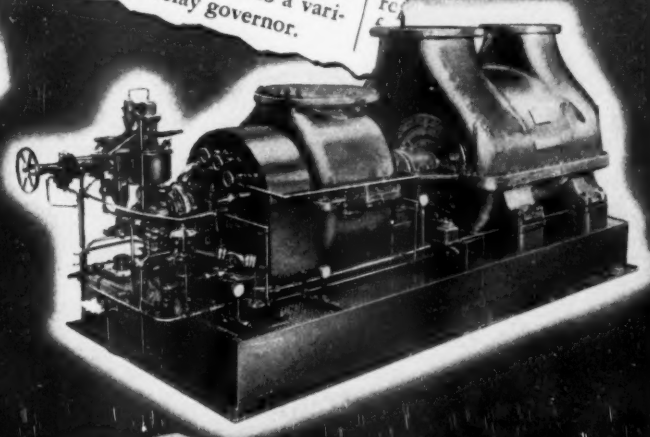
Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.





For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

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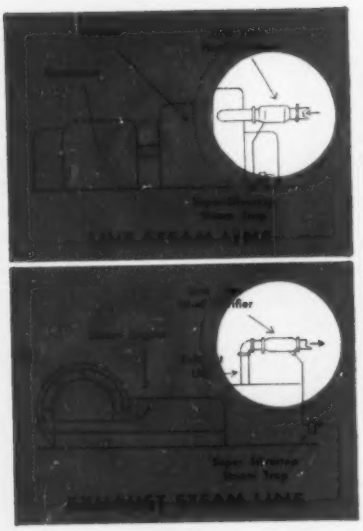

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More TECHNICAL BRIEFS

Begins on page 148

The burning bed of char, with a deficiency of oxygen being admitted to it, provides a reducing atmosphere for the reduction of the sodium sulfate to sodium sulfite. *APC Paper, no number.*

Directions for ordering papers on p 150

Preparation and Combustion of Explosion Pulverized Coal. *By C G Von Fredersdorff, Institute of Gas Technology, Chicago.*

A pilot unit comprising a two-stage flow nozzle-cyclonizer combination, operating with a 75 psig compressed air-coal ratio of 0.7 to 1.0 lb/lb, reduced, in a single pass operation, a hammermill pulverized stoker coal to a product analyzing up to 80% and above passing a No. 325 U.S. Sieve. This two-stage system operated at a considerably greater pulverizing efficiency than a single flow nozzle. It indicated, furthermore, that flow nozzles up to ½ inch in diameter used in the pilot unit did not pulverize as efficiently as ¼-inch diameter nozzles employed in the laboratory scale studies.

Combustion results were satisfactory with pulverized coal containing less than 1% plus 40 U.S. Sieve and up to 80% and above minus 325 U.S. Sieve material. Steam generation efficiencies were obtained comparable to normal pulverized coal firing practice.

This explosive pulverizer-cyclonizer system utilizes a combination of expansive action of a compressed gas (air) flowing through a nozzle plus frictional effect induced in a vortex chamber or cyclonizer to maintain a high degree of pulverization. This represents a continuous operation with no moving parts required for the actual pulverization. However, auxiliary equipment is required such as: (1) a hammermill to reduce lump coal to a size that can be accommodated in a flow nozzle, (2) a system of air classifiers to reject oversize particles upstream and downstream of the pulverization system, and (3) a pressure feeding system to deliver the coal charge to the compressed air stream. The coal device employed in this investigation, which consists of a continuous chain pressure conveyor having pneumatic seals at the discharge end, was unsatisfactory for prolonged operation due primarily to heavy wear causing air leakage and irregularities in the coal feed rate. An alternate method for the pressure feeding of pulverized coal might consist of a two-stage pressure tank operating intermittently.

Based on the requirements of 75 psig compressed air as the principal operating cost of the pulverizing step and assuming an air compression cost of 1-2

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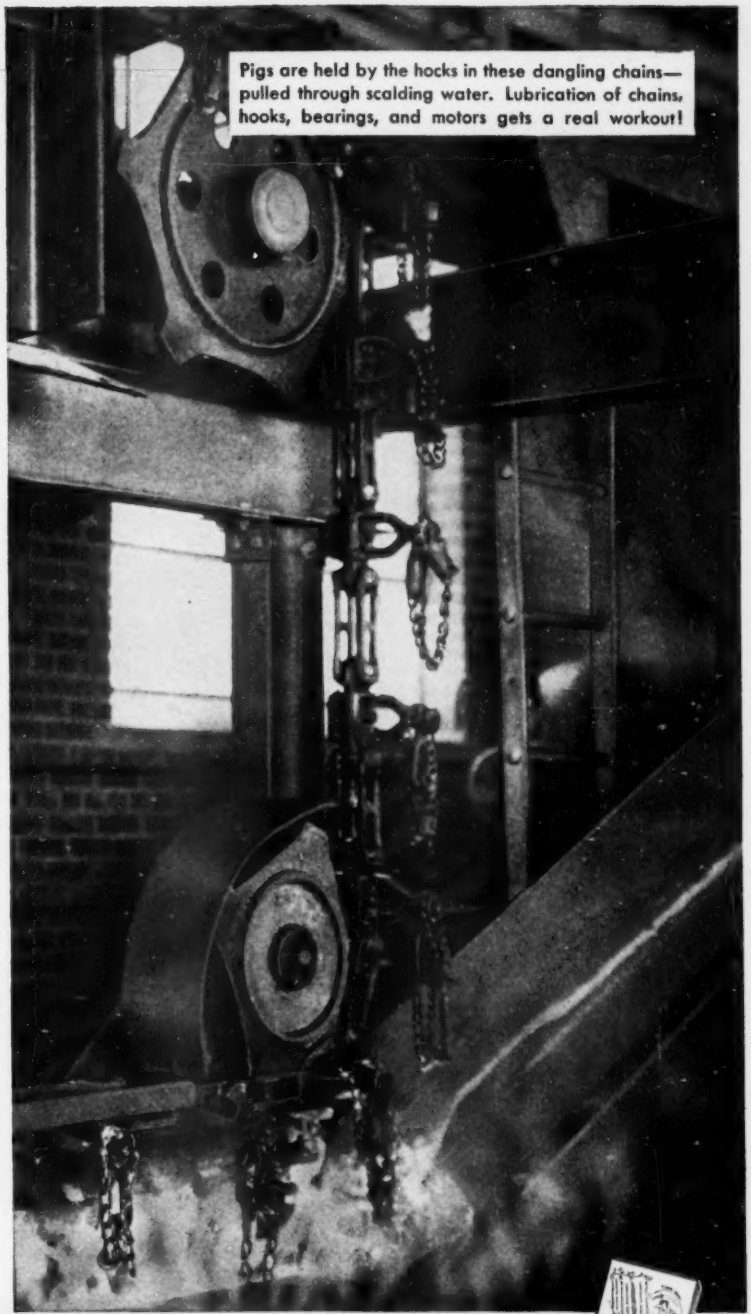

Pigs are held by the hocks in these dangling chains—pulled through scalding water. Lubrication of chains, hooks, bearings, and motors gets a real workout!

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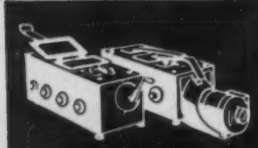

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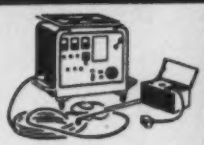

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More TECHNICAL BRIEFS

Begins on page 148

cents/mcf, it is estimated that the compressed air cost for the production of pulverized coal analyzing 80% minus 200 U.S. Sieve is approximately (0.65) x(2000)x(13.08)x(1.2)/1000 or 20.4 cents/ton. This is comparable to the cost of electricity in the operation of ball mills, normally ranging from 16 to 22 cents/ton coal pulverized, based on an electrical energy cost of 0.1 cent per kilowatt-hour. *APC Paper, no number.*

Directions for ordering papers on p 150

The Paper Mill Power Plant. *By Nyle C Austin.*

The paper industry consists of 762 paper mills and 255 pulp mills scattered throughout the United States and has a combined capacity of about 24,000,000 tons of paper per year. The products range from lightweight tissues to heavy container boards with each type, weight and grade having specific steam and power requirements. A small mill may have a steam consumption of 20,000 lbs per hr and a power demand of 1000 kw, while steam usage in the larger mills may average 500,000 lbs per hr with power demands over 25,000 kw.

Demands for low pressure steam run heavy so the average paper and pulp mill has the opportunity to economically generate all or part of its electrical requirements. It is on this basis that almost every power plant in the industry is designed. Paper mills built 25 to 50 years ago were able to obtain this balance with 150 or 200 psi saturated steam. But, as drying pressures were raised and electrical demands increased, higher initial steam pressures and temperatures became necessary. As an alternate to installing new higher pressure boilers and turbines, many mills turned to purchased power. Consequently, the average paper mill generates steam at two or sometimes three pressures, produces part of its power on back pressure or extraction turbines and purchases the balance of its requirements. Furthermore, as steam and power loads are always on the increase, the average power plant seldom has reserve capacity.

The successful operation of a power plant in the paper industry not only involves good operating practices but requires a complete knowledge of the processes in the paper mill itself. We find that it is usually up to the power engineer to check steam and power usage, initiate changes in processes or recommend new equipment in the mill which will maintain a heat balance or alleviate a steam or power shortage.

(*Continued on page* 232)

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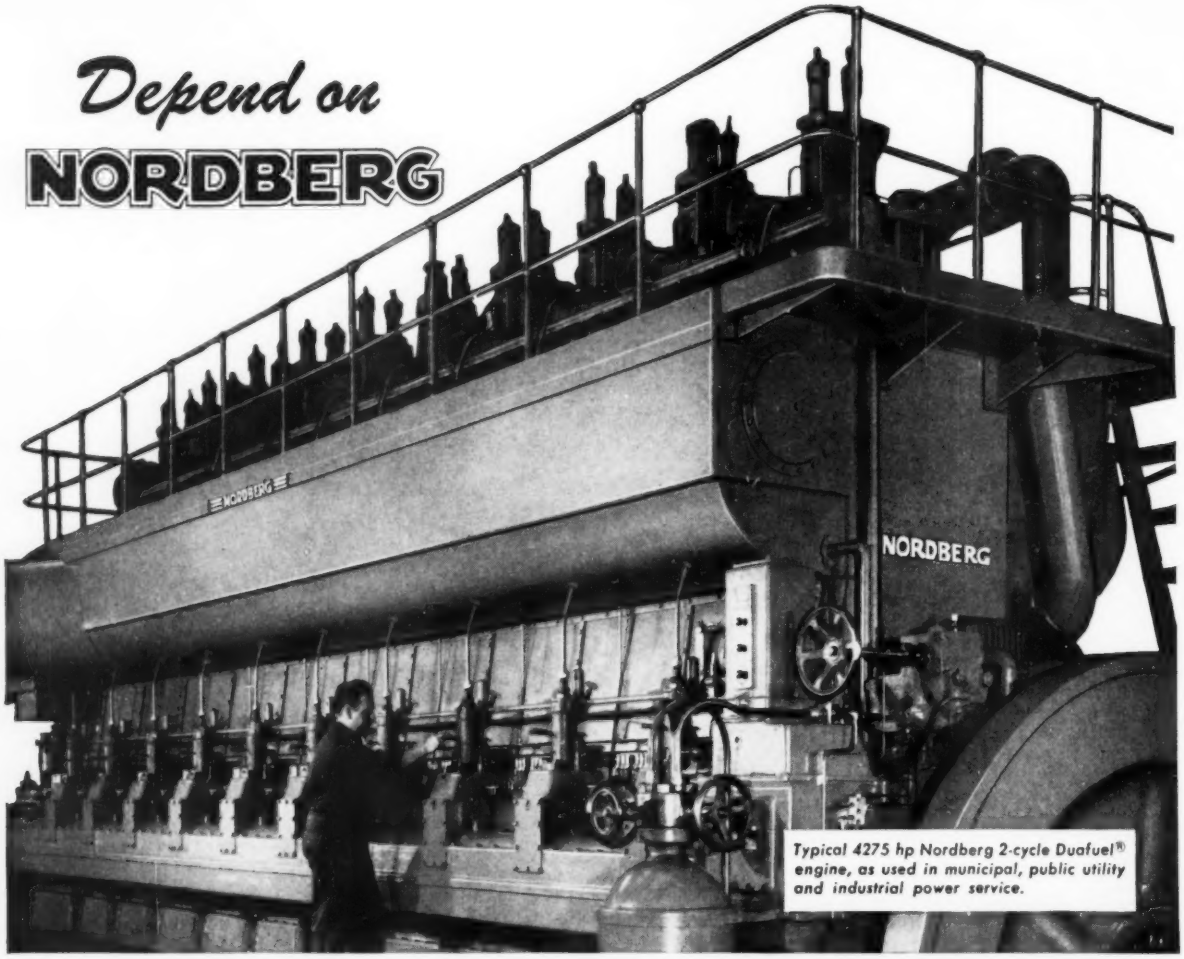

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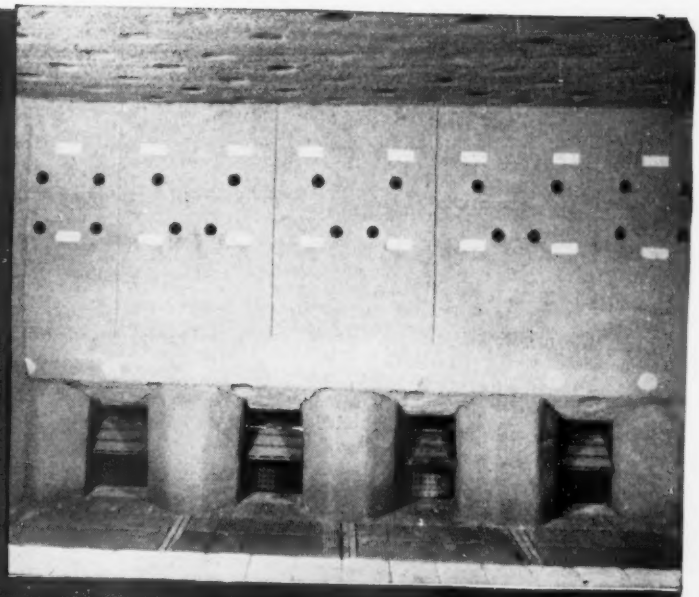

View of monolithic SUPER-PLASTIC [illegible] stoker openings, stoker piers, and ignition arch.

[illegible] over 30 years, A. P. Green plastic firebrick made from highest quality Missouri fire clays, has been proved in service. Three grades of plastic to meet varying refractory needs.

Looking toward bridge wall. Note the chrysolite arch built with SUPER-PLASTIC suspended construction without the use of special shapes.

These photos show an air-cooled setting installed in a large coal drier furnace with A. P. Green plastic firebrick. The entire firebox section—walls and flat suspended arch—was lined with A. P. Green SUPER-PLASTIC to withstand the high temperatures, severe slagging, and spalling conditions encountered in this area.

A properly engineered A. P. Green monolithic furnace lining is quickly and easily installed. There are no exposed joints open to attack by flame or slag . . . an airtight lining gives longer furnace life.

In A. P. Green monolithic construction, expansion and contraction are provided for by use of "floating" anchors. These anchors permit free wall movement, horizontally and vertically, yet provide positive anchorage to outer wall.

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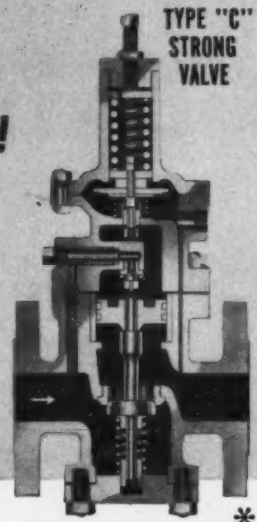

FOR HEATING OR PROCESS JOBS:

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- ... requiring accurate control;
- ... where dependability is essential.

For positive control, use this STRONG* single-seated, pilot-controlled valve!

Simple design, extra-heavy construction make STRONG's Type "C" regulating valve give trouble-free regulation. Semi-steel for pressures to 250 psi, 450° F.; cast steel to 600 psi, 750° F. With Anum-Metl† seat and disc, this valve automatically adjusts itself to control the flow of steam, air or gas required to maintain reduced pressure.

Write us about your pressure reducing problem or request our complete steam specialties Catalog 68-X.

TYPE "O"

Direct operated. Semi-steel construction suitable for initial pressures to 225 psi, 400° F. For steam, air, water or gas.

Features internal strainer, Anum-Metl† seat and disc. Direct operated, of extra heavy semi-steel, this valve is suitable for pressures to 225 psi, 400° F.

TYPE "K"

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
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† ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

No. 070 Small Trap | "SY" Strainer | 800 Series Steel Trap

STRONG

More TECHNICAL BRIEFS

Begins on page 148

The author then discusses the various areas where changes or close control will pay off. *APC Paper, no number.*

Directions for ordering papers on p 150

Trends in Combustion and Steam Temperature Control. *By P S Dickey, Bailey Meter Co.*

Since World War II the design of steam power plants has advanced at a phenomenal pace in an effort to hold down the cost of power generation in spite of increased cost of plant, fuel and supervision. The design changes which have had an important bearing on regulation of the steam generator are as follows:

1. A substantial increase in capacity with a corresponding increase in size and complexity of the fuel burning equipment.
2. Increased steam temperature with a corresponding need for closer temperature regulation over a wider load range.
3. Use of the reheat cycle which adds a second temperature control system likewise requiring close regulation over a substantial load range.
4. Adoption of centralized control for one, two or more boiler-turbine units which requires improved control and supervisory equipment and better design of the supervisory station to improve operator efficiency and minimize operating errors.

The principal functions of a suitable automatic control system for regulating a modern high-capacity, high-pressure and high-temperature steam generator are as follows:

1. To supply the correct amount of fuel and air to the furnace to release heat in accordance with the load demand.
2. To feed water to the boiler in accordance with steam demand. This is an important phase of regulation but will not be covered in this paper since we are dealing principally with the release and control of the heat supply.
3. To avoid any controllable losses due to excess air or incomplete combustion by proper fuel-air proportioning. A related requirement is providing against explosive atmospheres in the furnace and maintaining proper furnace pressures.
4. To distribute the heat released in the furnace to the evaporating and the superheating sections of the boiler in a proper relationship to produce the required quantity of steam at the desired pressure and temperature.
5. To arrange the instrumentation and control equipment for most efficient

the *AUTOMATIC* answer to DIVERSIFIED TEMPERATURE REGULATION PROBLEMS . . .

JOHNSON CONTROL

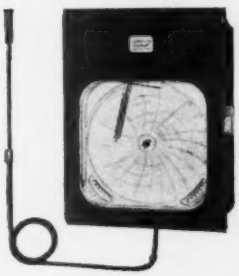
Owens-Corning Fiberglas Corp., Anderson, South Carolina. Lockwood-Greene Engineers, Inc., architects and engineers, New York and Spartanburg, S. C.; Carrier Corporation's Atlanta Office, air conditioning contractors.

Cloth from sand? Yes! That is what happens at the Owens-Corning Fiberglas plant at Anderson, South Carolina. Here, temperature and humidity conditions throughout the entire plant are controlled by Johnson.

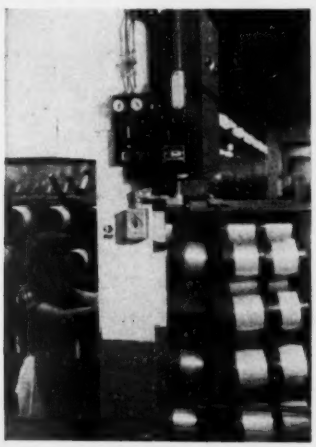
The Carrier centrifugal refrigeration machine, which furnishes the chilled water for cooling in connection with the air conditioning, is under the control of a Johnson T-1000 Single-Pen *Record-O-Stat*. In addition to acting as an accurate temperature controller, this instrument also insures that a continuous record of the temperature of the chilled water is always available for reference. This is important where industrial processes are dependent upon the space conditions. In the forming and finishing rooms, space temperatures are maintained at precise levels by Johnson T-800 Master and T-901 Submaster Thermostats which operate Johnson Valves and Damper Operators.

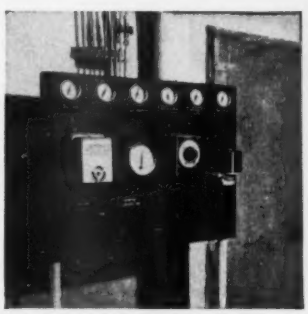
Finishing rooms, offices, cafeteria, shops, first aid room, kitchen and locker rooms are controlled by Johnson *Individual Room* Thermostats. All of the Johnson apparatus, engineered for the most exacting results, is combined into a complete Planned-for-the-Purpose, Installed-for-the-Purpose Control System. Another outstanding example of the adaptability of Johnson Control!

Whether *your* plant calls for the solution of intricate temperature and humidity control problems or merely the simple application of a single controller, call a Johnson engineer from a nearby Branch Office and get the benefit of over 60 years of experience offered by the *only* nationwide organization devoted exclusively to manufacturing, planning and installing automatic temperature and air conditioning control systems. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.



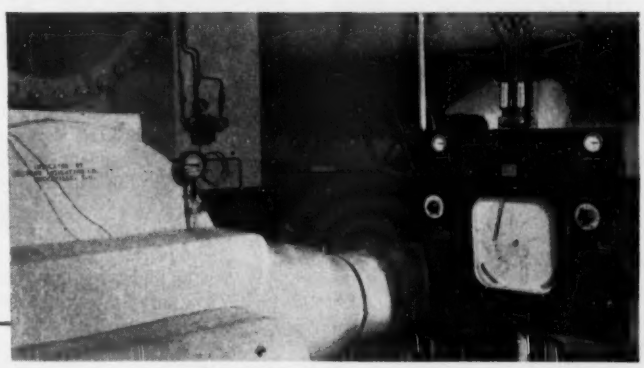
T-1000 Single-Pen *Record-O-Stat*



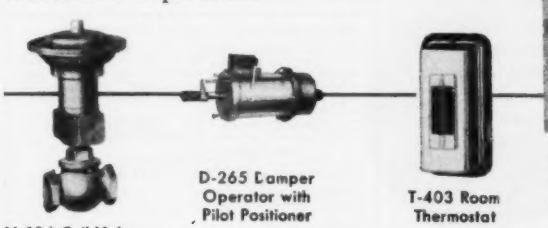


Temperatures in manufacturing and other areas are controlled by Johnson T-400 series Room Thermostats, one of which is shown above.

From control panel at left, a Johnson T-800 Thermostat controls the dew-point temperature of air leaving the air washer for the air conditioning unit serving a processing area.



Above, a Johnson T-1000 *Record-O-Stat* regulates and records the temperature of the chilled water leaving the Carrier centrifugal refrigeration machine.



V-104 Coil Valve

D-265 Damper Operator with Pilot Positioner

T-403 Room Thermostat

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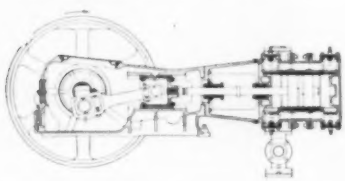
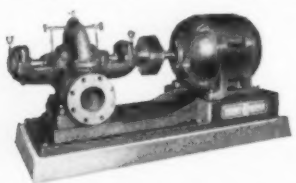
This Check Valve should be on EVERY reciprocating Compressor. Bulletin 509-H



OILFREAIR and OILFREGAS Compressors guaranteed to compress air or gas free of any trace of oil or oily vapors. They are unequaled for Instrumentation, Food and Chemical processing. Bulletin 202-H, 600-H



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OILFREAIR® THRUSTFRE®

OILFREGAS® AIRCHEK®

More TECHNICAL BRIEFS

Begins on page 148

operation and supervision during normal, emergency, and start-up operation. *APC Paper, no number.*

Mill Drying in Pulverizing High Moisture Coals. *By W C Rogers, Riley Stoker Corp.*

Avoiding pulverizer capacity reduction due to high coal moisture depends upon more than supplying enough heat to evaporate the moisture. Other factors, such as degree and duration of raw coal and air mixture to turbulence, and thermo-dynamic evaporative effects on total mixture flow, need consideration. This paper analyzes these factors and their effect upon performance using data obtained in both experimental and field investigations.

High moisture in coal, with pulverized fuel firing, affects preparation equipment more than it does with any other coal burning equipment. In addition to handling extremely wet coal, you suffer from reduced coal crushing capacity and coal conveyor and bunker stoppages. Further complications arise when wet fuel must be passed through raw coal feeders and pulverizing equipment. Ordinarily, high moisture coal periods amount to perhaps 15 days per year in an average installation. Yet with pulverized coal firing you find trouble in handling the coal when its free moisture percentage exceeds 8 or 10%.

Directions for ordering papers on p 150

Perhaps it is the pulverizer itself that suffers most. Since the high moisture in coal occurs only occasionally, the handling and feeding difficulties may be overcome by judicious use of manpower and mechanical aids. However, once the wet coal reaches the pulverizer there is little that can be done. But there are two ways to design pulverized coal-fired units to avoid reduction in steaming capacity with high moisture coals: (1) Provide a sufficient quantity of primary air at a high enough temperature to dry out at least all of the surface moisture and permit the pulverizer to discharge the pulverized coal and air at a sufficiently high temperature to avoid condensation of moisture or sticking of coal in the discharge lines to burners. (2) Provide excess grinding capacity in the coal pulverizers. The unit can still maintain the desired steaming rate. This second method is rather expensive because the excess capacity works only 5% of the total service time.

Both of these methods are merely palliatives. We believe it is possible to handle satisfactorily high moisture coals within the pulverizer itself by: (1)

GAS TURBINE ANALYSIS AND PRACTICE

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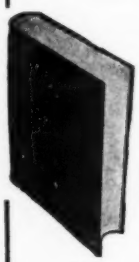
A broad, overall survey of the design, operation, and scope of the modern gas turbine, and its application in various fields of transportation and power. Discusses various types, gives specifications, sketches, and photos, shows how to calculate thermodynamic performance, and outlines fundamental concepts necessary in design work. **By Burgess H. Jennings and Willard L. Rogers, both of the Technological Inst., Northwestern U. 487 pp., 200 illus., $8.50**



Just Published!

ELEMENTS of INTERNAL COMBUSTION ENGINES

A direct and helpful guide to the physical, chemical, and mechanical factors affecting the performance of stationary, marine, aircraft, diesel, and other types of internal combustion engines. Enables you to determine the type of engine best suited to a particular job, and how to keep it operating at maximum efficiency. **By A. R. Rogowski, Assoc. Prof. of Mech. Engr., M.I.T. 234 pp., 115 illus., $5.50**

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Just Published!

A practical view of the working and application of just those automatic controls used in the heating, ventilating, and air-conditioning field. Covers electric and pneumatic control of domestic heating, unit heaters and ventilators, commercial heating, cooling, and refrigeration systems, and radiant-panel heating. **By John E. Haynes, Vice-Pres., Minneapolis-Honeywell Regulator Co. 354 pp., 200 illus., $6.75**

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Condensed into this one book are all the tips, methods and techniques essential to more effective practices in industrial and construction operations. Deals with everyday maintenance operations—with the transportation and handling of heavy machinery—with the erection and demolition of smaller size structures. Covers everything from ropes, hoisting chains and hooks, to slings and ladders. **By W. E. Rossnagel, Safety Eng'r. 321 pp., over 300 illus., $6.00**

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Position P-9

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"Our Schramm 105 is operating 16 hours a day", writes H. J. Lockwood, Plant Superintendent, Mullenbach Electrical Manufacturing Company, Los Angeles, "and during the day shift is on a 75% duty cycle.

"Considering that our usage of air at the time of the installation a year ago was 15% duty cycle, you can see how we have put air to work for us".

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More TECHNICAL BRIEFS

Begins on page 148

Establishing ahead of the pulverizer proper a region of very high turbulence where all heated primary air mixes with all coal in the most violent fashion practical and for a long enough time to vaporize essentially all surface moisture. The greater the turbulence the shorter the time required and the smaller the physical dimensions of the drying end need be. (2) Being certain all drying takes place within the turbulent region and not beyond, to avoid building up mounds of partly dried coal fines in passages leading into the main pulverizing region and upon pulverizer grinding elements. This very action reduces performance values of most commercial coal pulverizers with wet coal. (3) Recognizing the vapor addition to the mill transport air as a result of the drying process, and that it in effect lowers the net primary air admitted compared to that when grinding at the same dry coal rate. As a result you need higher primary air temperatures. (4) Taking steps to assure higher primary air temperatures than usually available from air preheaters. Unless you follow the rather unsatisfactory course of using furnace gases. This means expensive auxiliary primary air preheaters. In many cases a small separately fired (gas or oil) primary air booster preheater pays for itself since the investment in equipment is low and the auxiliary fuel of minor cost for the occasional help you need. *ASME Paper No. 53-S-47.*

Directions for ordering papers on p 150

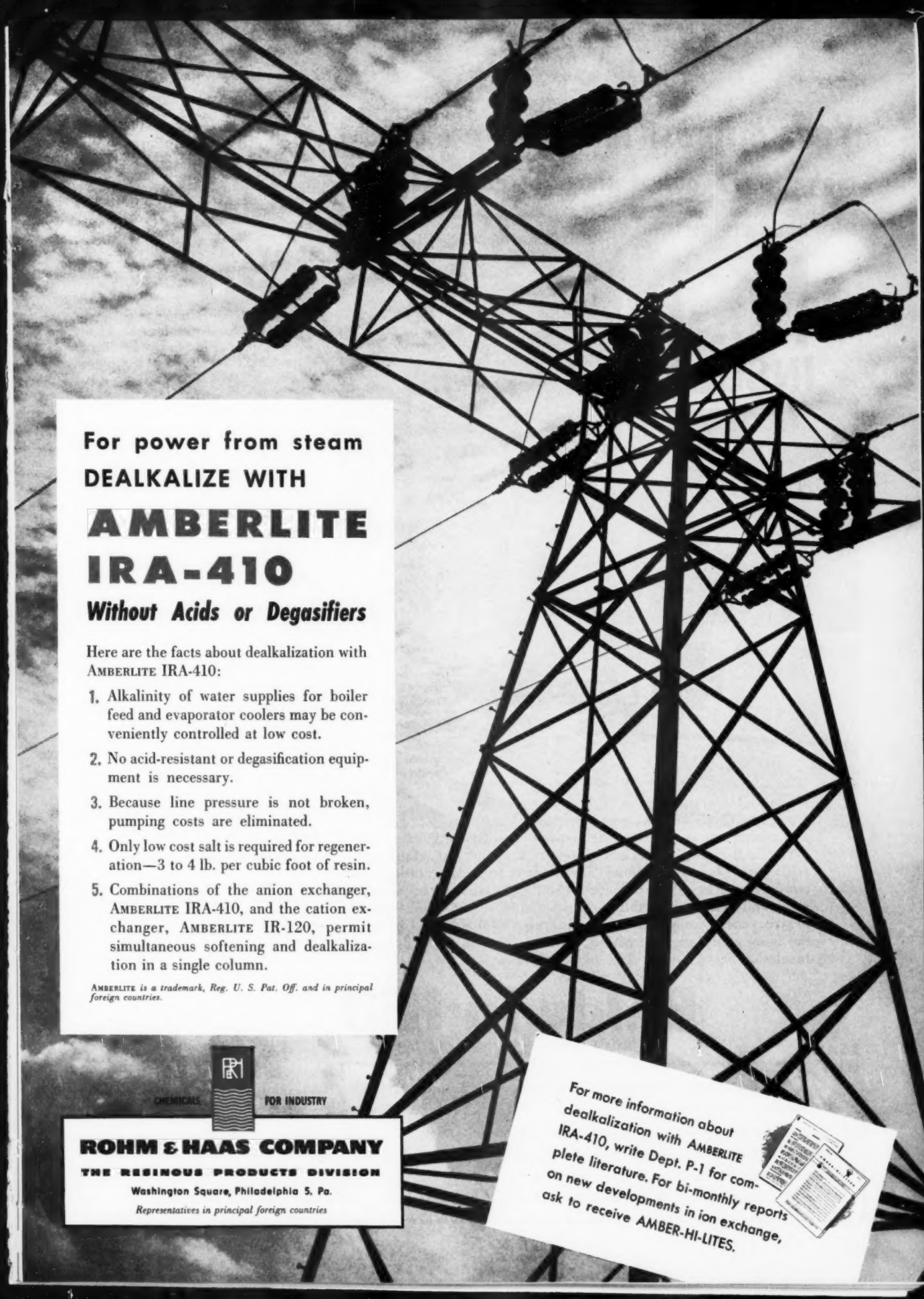
The Solubility of Oxygen in Water. *By L M Zoss, Taylor Instrument Co, S Suciu, General Electric Co, and W L Sibbitt, Purdue University.*

The increasing application of high temperatures and pressures makes it necessary to know the solubilities of compressed gases in water for engineering design purposes. A survey of the literature reveals that data for the solubility of oxygen in water are meager. These investigations are summarized in table form.

This work was a continuation of earlier investigation by the same authors.

The apparatus consisted of a high pressure vessel with integral vapor and liquid sample chambers, heaters and temperature controls and auxiliary pumps and analytical equipment.

The sequence of operations follows: (1) the pressure vessel was evacuated, (2) charged with a known volume of water, (3) brought to a selected temperature level, (4) charged with gas (under conditions of constant total pres-



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Without Acids or Degasifiers

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1. Alkalinity of water supplies for boiler feed and evaporator coolers may be conveniently controlled at low cost.
2. No acid-resistant or degasification equipment is necessary.
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5. Combinations of the anion exchanger, AMBERLITE IRA-410, and the cation exchanger, AMBERLITE IR-120, permit simultaneous softening and dealkalization in a single column.

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More TECHNICAL BRIEFS

Begins on page 148

sure, constant temperature, and continuous agitation) until phase equilibrium was attained, (5) fastened in a vertical position until the vapor and liquid phases separated.

Oxygen shows unusually high solubility at 32 F. The solubility decreases with the increasing temperature in the range from 32 to 200 F and then increases with increasing temperature.

At room temperature where the gas solubility is small the fugacity of the water in the liquid phase may be calculated from Raoult's law. If the pressure change is small then Henry's law applies to the dissolved gas. When the solubilities of gases are measured at high pressures then the influence of pressure cannot be disregarded; consequently the usual expression for Henry's law must be corrected. Knowledge of partial molal volume of dissolved gas is needed to make this correction and these data for oxygen are not available. *ASME Paper No. 53-S-30.*

More POWER NEWS

Begins on page 146

about 10 psi from the flow stations. They will use about 10% of this gas as fuel and will pump the remainder to the wells at a pressure approaching 2000 psi.

Turbines were chosen for this use because their low vibration permits simplification in the design of the mounting platforms. All of the two-shaft, simple-cycle units, rated at 6000 hp each, should be in operation by July 1954.

Four More Pump Motors Go To Coulee Irrigation Service

FOUR ADDITIONAL 65,000-hp synchronous motors went into irrigation service on May 19 at Grand Coulee Dam. Built by Westinghouse Electric Corp, they are identical to the first two motor and centrifugal pump units installed in 1951. These six motors are the largest ever put into service.

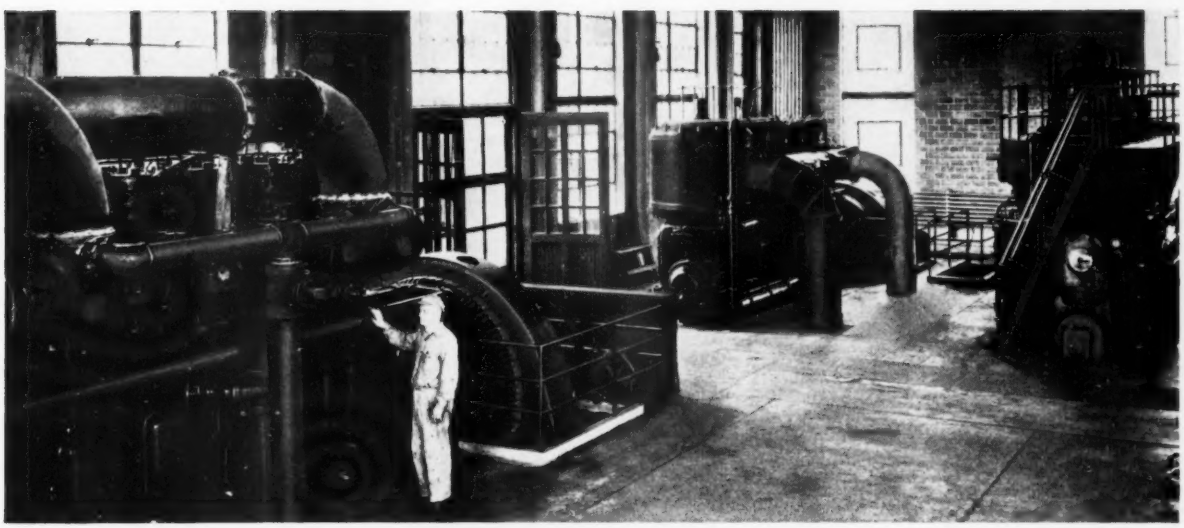
Each motor drives a pump rated 1350 cfs under a 310-ft head. Each lifts more than a billion gallons of water per day into a canal 280 ft above the storage reservoir behind the dam. The water is lifted through 13-ft conduits 800 ft long.

The six motors now installed receive power at 13,800 v from three of the eighteen 108,000-kw generators located at the dam. Two motors receive power directly from each generator.

Federal officials hope to install six more similar pump-motor units to make possible the irrigation of a million acres

H. L. Ostness, Chief Engineer, River Falls Municipal Utility, Wisconsin, says...

"Sticking Rings are no problem in this Plant"



Mr. Ostness, as chief engineer of one of the oldest Municipal Power Plants in Wisconsin, knows diesels – *knows how to get the most out of them.* Mr. Ostness recently wrote, "We have used Sinclair Lubricants for over fifteen years very successfully. GASCON® and RUBILENE® H.D. have been doing an outstanding job in our diesels. Stuck rings is a trouble we know nothing about – engine wear is at an absolute minimum. With results like these, we'd recommend Sinclair Lubricants any time."

If your present lubricants do less, why not let Sinclair help you get longer life from your diesels – with less trouble. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

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save wear and replacement

EXTRA YEARS OF MORE DEPENDABLE POWER

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When in need of boiler, condenser, heat exchanger, evaporator, stationary, marine or railroad tubular equipment, call a Murray warehouse first and be sure of quick and dependable tubing service.

Photo courtesy of The M. W. Kellogg Co., Inc.

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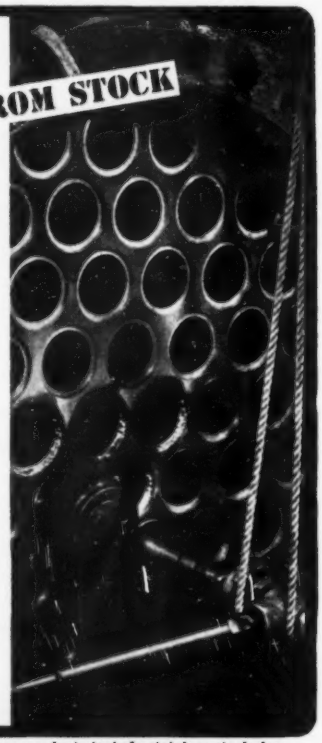

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Other Murray products include stainless steel pipe, tubing and fittings, IPS pressure tubing, seamless cold-drawn and hot finished mechanical tubing, seamless and welded pipe, JIC hydraulic tubing, carbon steel welding fittings and all types of tube fabricating to order.

7271

More POWER NEWS

Begins on page 148

of new farmland. The two pumps in operation last year delivered water to 66,000 acres. Pumping is done only during late spring and summer when there is a surplus of water and electric power.

Coming Events

Sept 18-20—Instrument Society of America, Preconference ISA Instrument Maintenance Clinic, Morrison Hotel, Chicago, Ill. Details from Nat'l Office of ISA, 1319 Allegheny Ave, Pittsburgh 33, Pa.

Sept 29-Oct 1—American Institute of Electrical Engineers, Middle Eastern District Meeting, Daniel Boone Hotel, Charleston, W. Va. Details from Raymond C Mayer Associates, 9 Rockefeller Pl, New York, N. Y.

Oct 8-9th—9th Nat'l Conference on Industrial Hydraulics, Sheraton Hotel, Chicago, Ill. Details from John G Duba, conference secretary, Illinois Institute of Technology.

Nov 9-12—8th All-Industry Refrigerating & Air Conditioning Exposition, Public Auditorium, Cleveland, Ohio. Details from 8th All-Industry Refrigerating & Air Conditioning Exposition, 1346 Connecticut Ave, NW, Washington 6, D. C.

Power Across the Nation

Southern California Edison Co has started site-clearing for its $8½-million Vermillion Valley power reservoir. A further development of the Big-Creek-San Joaquin facilities, this project will permit addition of an annual 122-million kwh to present output of the six existing powerhouses in the area, or as much as 440-million kwh in exceptionally dry years.

The company has also ordered a 125,000-kw turbine-generator unit with a 10,000-kw auxiliary generator from Westinghouse Electric Corp. One of the largest single-shaft turbine-generators on order, the unit will go to the Redondo Beach Steam Station No. 2 about 25 miles southwest of Los Angeles.

Commonwealth Edison Co of Chicago has started operating its new Jefferson substation. One of the major installations of its kind in the country, it is part of a program to expand the high-voltage transmission system to bring bulk power to metropolitan load centers.

Utah Power & Light Co plans an expansion program to include (1) a 100,000-kw steam-electric plant in Salt Lake City to cost $16-million and (2) a 66,000-kw steam electric plant at Castle Gate to cost $10½-million. Completion dates are 1955 for Salt Lake City and 1954 for Castle Gate.

(*More* Power News *on page* 242)

Ray-Man "F" Conveyor Belt—More use per dollar
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ON ABUSIVE HAULS... Ray-Man "F" will cut costs where your conveyor belts are commonly exposed to tearing or puncturing . . . where pulleys are small . . . where fastener failure is a particular problem. The unique properties of synthetic fiber strength members make possible these advantages. Ray-Man "F" also gives you everything you require in a general purpose belt—flexibility, troughability, impact resilience, ease of training, strong cover adhesion—MORE USE PER DOLLAR. Ask the R/M distributor for Bulletin 6915. Ask him, too, about Homocord, R/M's extra-cushioned conveyor belt for heavy impact loading. R/M field engineers back him up to give you MORE USE PER DOLLAR—not only in conveyor belts, but in hose, transmission and V-belts.

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MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

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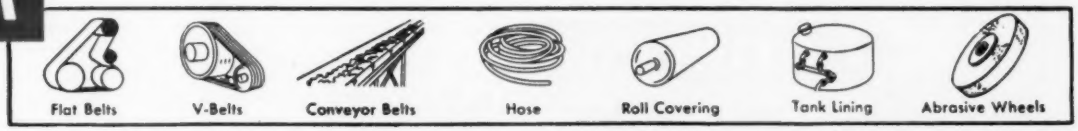


Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Packings • Brake Linings • Brake Blocks Clutch Facings • Asbestos Textiles • Sintered Metal Parts • Bowling Balls

no other valve like–

Here's why...

- *a Much Higher capacity* per size, than any other valve.
- *a free-acting, self-aligning disc.*
- a *"floating" guide* (readily adjustable for control) . . . assists in opening and closing action, as well as affording an additional self-aligning feature.
- a Disc and Disc holder of *forged copper alloy,* not castings.

Briefly, these "features" offer the following advantages:

Reduction in size of boiler opening required to mount valve, due to *larger capacity* from smaller valve sizes — and thus reduced cost of discharge piping. Reduction in boiler head-room. Reduction in shipping charges (less weight). Easier and more positive operations. Easy replacement or re-conditioning of working parts (low maintenance).

Available in sizes from 1½" through 6", Lonergan UNI-LINE Valves are V & W National Board approved design . . . product engineered for economy. (A leading boiler manufacturer, name available, has tested, approved and highly appraised all claims.) Write for new descriptive literature.

Lonergan

J. E. LONERGAN COMPANY

ESTABLISHED 1872

2ND & RACE STREETS • PHILA. 6, PA.

More POWER NEWS

Begins on page 148

Consolidated Products Acquires Condenser Service & Engrg Co

Consolidated Products Co, Inc, 15 Park Row, New York City, has acquired ownership of Condenser Service & Engineering Co, Inc, Hoboken, N. J. and its various affiliated companies. The absorbed company represents assets of more than $3-million, according to Herman Kahn, president of Consolidated.

Kahn also reported that William M Kennedy, former president of Condenser Service, will retain active participation as chairman of the board of directors and Maurice Grober will continue as general manager of the condenser service. Personnel of the merged group will be maintained.

Affiliated companies of Condenser Service & Engrg include Edge Moor Iron Works, Inc, Edge Moor, Del.; Scranton Pump Div, Blackburn-Smith Mfg Co, Inc; Instrument Service Co.

Some Pro's and Con's On Commercial Atomic Power

The Atomic Energy Commission has awarded a contract to Walter Kidde Nuclear Laboratories, Inc to make a design study of a nuclear power plant for use in an isolated, high-cost power area. The study will concentrate on a single-purpose reactor using light water as a combined moderator-coolant.

One of the first privately-financed independent laboratories devoted to development of commercial atomic power, Walter Kidde has directed a major part of its efforts toward producing a low-cost reactor. The AEC contract calls for a detailed analysis of architect-engineer, construction and operating costs for a four-year period. Also, the study, to be completed late in 1953, must point out the effect of site location upon reactor design and power cost.

Radiation detection devices that literally 'see the heat' comprise the heart of a new robot system that's 10 times faster and 2 to 5 times more accurate than previous systems used in monitoring critical temperatures during uranium rolling operations.

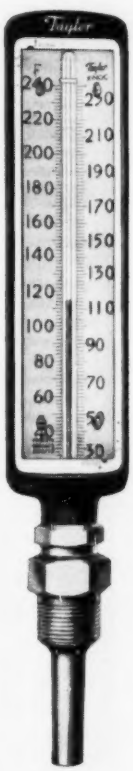
Developed by Minneapolis-Honeywell Regulator Co, the new system is now monitoring volume production at the AEC's Ohio production center. The radiation devices, called radiamatic pyrometers, function as 'pick-up' elements comparable to electric eyes. They detect the temperature, or heat, of the uranium ingot at several points in the production line and relay the information to a series of electronic recording

(*More* Power News *on page* 244)

Taylor has an honest face!

6" Dial Indicator with all-new movement design gives greater accuracy, greater flexibility of adjustment and greater convenience, for temperature, pressure and load applications. For temperature, short range spans from minus 100° to +1200°F. For pressure from 12 psi to 20,000 psi. New die-cast aluminum case can be face or flush mounted, is fume and moisture proof. Special pointer permits easy accurate zero settings. **Write for Bulletin 98214.**

Taylor Industrial Thermometer has exclusive, 3-times-easier-to-read BINOC* tube. Fast, precise indications. Available in wide variety of stem angles and connections, and in many standard ranges within minus 40° to +950°F or equivalent Centigrade. **Write for Catalog E.**



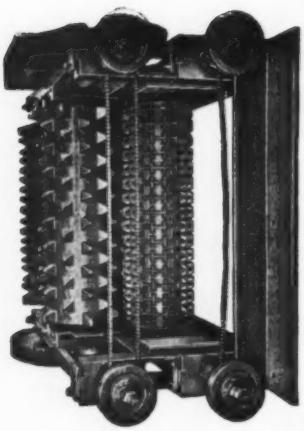
Taylor Recording Thermometer gives accurate minute-by-minute chart record of temperature. Mercury, vapor, gas or organic liquid actuation. Temperature range minus 125° to +1200°F or equivalent Centigrade. Hundreds of charts with short or long ranges to choose from, and a wide variety of bulb forms and connecting tubing, both armored and unarmored. One, two or three pen models. **Write for Catalog 76J.**

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

Taylor Instrument Companies
Rochester, N. Y., and Toronto, Canada

*Reg. U. S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST



TWO STAGE — DOUBLY ADJUSTABLE

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

More POWER NEWS

Begins on page 148

instruments. This permits a single operator to make necessary adjustments.

ATOMIC POWER PLANTS for producing electric power would be too costly to justify building them now, according to General Electric's top atomic energy executive. Testifying before a joint Congressional committee, Frances K McCune said that technical and practical problems barring wide-scale production of atomic power would be solved, but that it is not certain this will occur in any short period of time.

The GE executive said greater incentive and freedom would speed atomic energy development. Operators should be licensed, he continued, but this should not carry with it a requirement that technical data be furnished the government except on grounds of health, safety or national security.

McCune stated that, despite recent declassification measures, the great body of information in this country is restricted. He further urged that Congress make the decision between security through complete secrecy and security through progress made possible by industry sharing atomic information.

More FREE BULLETINS

Begins on page 161

14 **High-pressure,** force-feed lubricators for service up to 30,000 lbs described in 11-page, 2-color illustrated booklet. Consist of four integral pump assemblies mounted on cast iron reservoir and connected to gear motor attached to rigid base. Photos and full specs. Catalog 25G, Manzel Div of Frontier Industries, Inc, Buffalo, N. Y.

CONTROLS

15 **Hydraulic actuator** combining pneumatic and hydraulic principles described in illustrated color folder. "Pneu-Draulic" operator offers reduced maintenance, high reclosing speed, high efficiency. Bulletin 71B7942, Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

16 **Pneumatic control** accessories treated in 18-page, 2-color catalog. Drawings, photos, full specs for wide variety of controls. Catalog 8950. Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

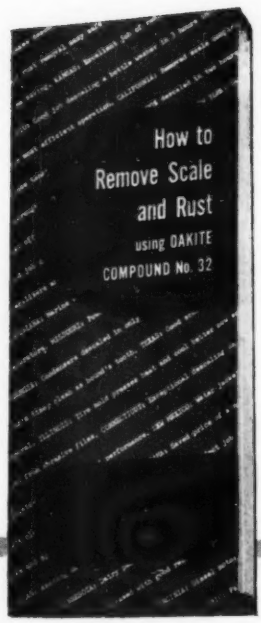
17 **Thermostatic switch** with accuracy of .2 F in ranges of –40 to 600 F described in illustrated leaflet. Operates by expanding tube housing with stationary internal parts. Scaico, Inc, Palmyra, N. J.

ELECTRICAL EQUIPMENT

18 **Dry-type indoor** current transformers, 600 v, 25/60 cycles, 200 to 800 amps covered in illustrated leaflet. Dimensional drawings and specs incl. Bulletin GEC-956, General Electric Co, Schenectady 5, N. Y.

19 **Motor, control and gearing** applications in modern coal mining analyzed in 26-page, 2-color booklet. Design of motors anticipates problems of dust, dirt, shock and explosion. Photos and cutaways of standard and special equipment. Booklet B-5619, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

(Continued on page 246)



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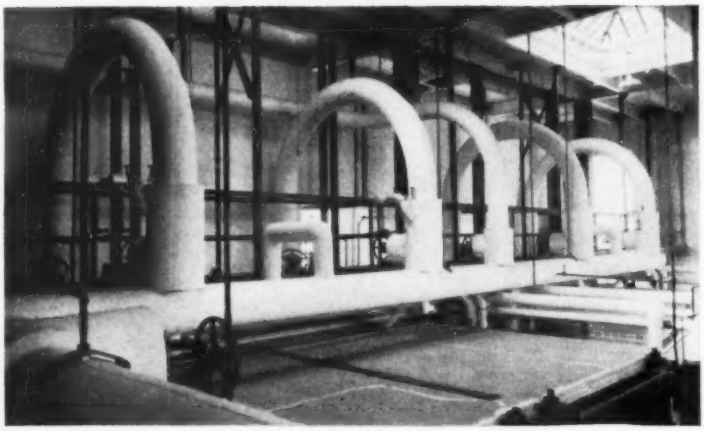

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More FREE BULLETINS

Begins on page 161

20 **Gearmotors** featuring wide selection of compact power units with single, double or triple-speed reduction presented in 2-color, 4-page folder. Photos and cutaways. Elliot Co, Crocker-Wheeler Div, Ampere, N. J.

21 **Selenium rectifiers,** developed specifically for magnetic amplifier circuits and sensing devices, described in 8-page booklet. Tables, formulas, examples provided to aid in selection of dimensions for particular cell sizes and combinations. Booklet TD-52-650, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

22 **Solderless wire connectors** and specialized electrical fittings featured in 16-page, 2-color catalog. Photos, dimensional data, specs, application instructions and ordering information incl. Catalog 53, Buchanan Electrical Products Corp, Hillside, N. J.

23 **Variable-rpm motor drives** discussed in 15-page, 4-color booklet. Outstanding features of full line of drives presented with photos, cutaways, operation graphs, and full specs. Bulletin 1797, U. S. Electrical Motors, Inc, Milford, Conn.

24 **Dc motors,** ½ to 300 hp, and dc generators, ¾ to 250 kw, presented in 16-page bulletin. Offers details of construction, enclosures, operating conditions. Photos, cutaways, specs. Bulletin 1450, Louis Allis Co, Milwaukee 7, Wis.

MAINTENANCE, SAFETY EQUIPMENT

25 **Plastic materials** of construction described in 35-page, illustrated booklet. Contains technical abstracts covering various applications of industrial plastics. Atlas Mineral Products Co, Mertztown, Pa.

26 **All-purpose steel framing** for wide variety of mechanical and electrical supports and mounts presented in 2-color, 4-page leaflet. Sizes and order number incl. Form GC 153-A25, American Steel and Iron Works, 58th at S Lowe Ave, Chicago 21, Ill.

27 **Floor anchor plates** discussed in 4-page, 2-color folder. Photos show typical installations. Folder STEL2252, Armco Drainage & Metal Products, Inc, 2252 Curtis St, Middletown, Ohio.

28 **High pressure,** interlocking bronze and steel flexible hose, tar and asphalt hose and necessary couplings covered in illustrated booklet. Lists current application, full test and engrg data. Bulletin 15-D, Atlantic Metal Hose Co, Inc, 123 W 64th St, New York 23, N. Y.

29 **Portable power tools** presented in 30-page, illustrated catalog. Information and specs on hammers, drills, screwdrivers, nut-runners, polishers, sanders, grinders. Catalog 537, Syntron Co, 492 Lexington Ave, Homer City, Pa.

30 **Fire pumps,** horizontal single-stage and vertical multi-stage, described in 4-page folder. Photos, cutaways, sketches and dimensions incl. Form 7226, Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

31 **Precision toolroom lathe** illustrated and described in 18-page catalog. Features Model 1020 lathe designed for precision as well as power. Catalog 1020B, Rivett Lathe & Grinder, Inc, Brighton 35, Boston, Mass.

MATERIALS HANDLING

32 **Floor level handling** of goods and full line of related equipment discussed in 100-page illustrated catalog. Information and specs on trucks, tractors, skids, lifts, etc. Catalog 535, Barrett-Cravens Co, 4609 S Western Blvd, Chicago 9, Ill.

33 **Diesel-powered** crawler tractors and a variety of applications covered in 10-page folder. Photos, cutaways, sectional views and full specs

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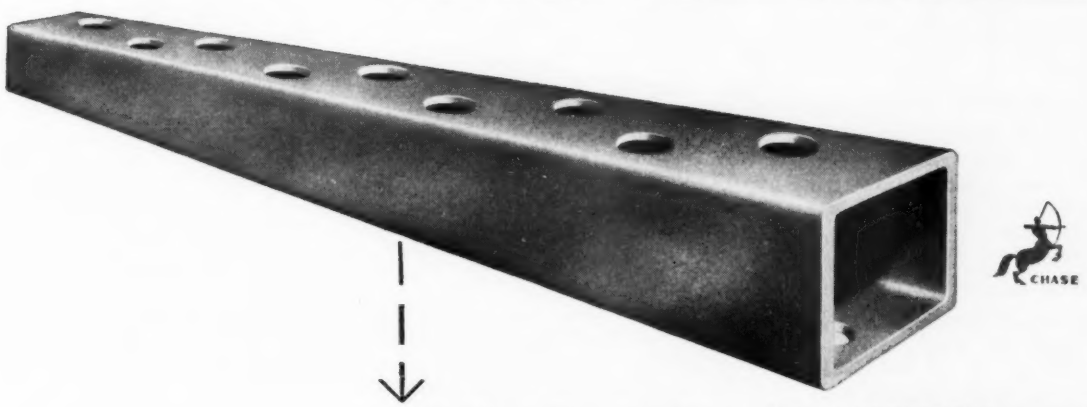
with CHASE® COPPER BUS CONDUCTORS



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Chase one-piece square copper tube buses have high mechanical strength in all directions. Large cross-sectional areas give them maximum structural strength. And that adds up to *longer spans between supports without unduly large sag.*

And, of course, Chase one-piece buses have the mechanical strength necessary to stand up under heavy short circuits.

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Repels Water
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Proved effective as a switch lubricant; also as a release agent to keep switches operable under icing conditions.

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More FREE BULLETINS

Begins on page 161

incl. Catalog 599, Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

34 **Centrifugal loaders,** car pullers, bin level controls, hoists and winches, speed reducers, conveyor belt cleaners, holdbacks and carriers covered in 4-page, illustrated folder. Bulletin 653, Stephens-Adamson Mfg Co, Aurora, Ill.

35 **Electric-transmission** fork lift truck that uses no clutch, transmission, controller or resistors featured in 6-page, illustrated folder. Special design features, dimensions and specs. Bulletin 1344, Baker Raulang Co, Cleveland 2, Ohio.

36 **Tractor-loader** with hydraulic torque-converter drive and clutch-type transmission described in 6-page illustrated folder. Ordering information, dimensions, full specs incl. Tractomotive Corp, Deerfield, Ill.

37 **Pull-type scrapers,** tractors, graders and power units covered in two 3-color, 12-page brochures. Photos and complete specs incl. Catalogs 595 and 601, Allis-Chalmers Mfg Co, Tractor Div, Milwaukee 1, Wis.

38 **Overhead electric** traveling cranes discussed in illustrated catalog. Presents low-head, grab-bucket, mill and Gantry type cranes in capacities from 5 to 350 tons and up. Bedford Fdry & Mach Co, Inc, Bedford, Ind.

MECHANICAL TRANSMISSION

39 **Industrial V-belts** and their applications discussed in 60-page engrg catalog. Contains 16 pages and 23 tables prepared for quick calculation of drives. Durkee-Atwood Co, Dept 411, Minneapolis 13, Minn.

40 **Chain belts** presented in 2-color, 4-page folder featuring "R," "RX," "RR" series of *Chabelco* chains. Photos, exploded views, full specs. Bulletin 53-59, Chain Belt Co, Milwaukee 1, Wis.

41 **Roller chain and sprockets** described in 24-page bulletin. Selection data, sectional drawings, price lists, and full specs incl. Bulletin A-624, Dodge Mfg Corp, Mishawaka, Ind.

42 **Cast and steel chain,** cast tooth sprockets, belt conveyor idlers, spray nozzles covered in 56-page, illustrated catalog. Specs and price lists for all equipment incl. Bulletin 53-110, Chain Belt Co, Milwaukee 1, Wis.

43 **Torque limiting,** slip-type friction clutches described in illustrated data sheet. Includes dimensions and capacities for 4¼, 5½, 6¼-in. dia clutches. Form S31-53, Morse Chain Co, 7601 Central Ave, Dertoit 10, Mich.

44 **Miniature combination** variable and fixed ratio speed changers offered in illustrated data sheet. Photos, diagrams, full specs incl. Data sheet MI, Metron Instrument Co, 432 Lincoln St, Denver 3, Colo.

METERS & INSTRUMENTS

45 **Pressure and vacuum gauges** treated in 2-color, 32-page catalog. Covers indicators, recorders, pneumatic and electric controllers and pneumatic transmission. Photos and specs incl. Catalog 7001, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

46 **Measuring equipment** ranging from simple current indicators to automatic oscillographs presented in 64-page catalog. Contains photos and specs for more than 115 devices. Bulletin GEC-1016A, General Electric Co, Schenectady 5, N. Y.

47 **Oxygen measurement** without the use of filaments, catalysts, chemicals and other secondary methods discussed in Bulletin 108. Arnold O Beckman, Inc, 1020 Mission St, S Pasadena, Calif.

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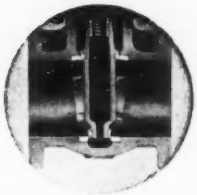
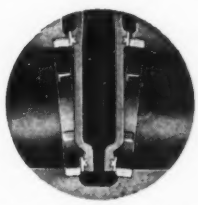
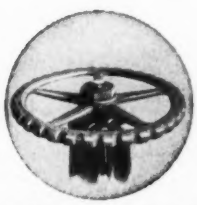


Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.



Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.

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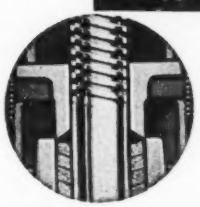
iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.



Brass Liner on Glands assures greater resistance to corrosion and scoring.

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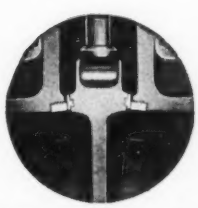
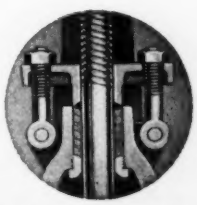


T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

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Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

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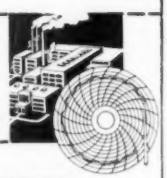
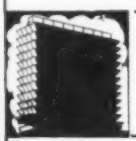
Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





3 COOLING WATER TREATMENT AND ALGAECIDE

Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

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Begins on page 161

electro-acoustical measurement instruments presented in 2-color, 34-page booklet. ★Request direct on company letterhead to Brush Electronics Co, 3405 Perkins Ave, Cleveland 14, Ohio.

PIPING, VALVES, FITTINGS

48 **Valves,** electrically and mechanically actuated, and accessories for flow control of water, gas, air, steam and oil presented in two illustrated releases from German firm. All valves are of cast iron, cast steel or special alloys depending on purpose of each. Vereinigte Armaturen Gesellschaft MBH, Mannheim, Germany.

49 **Valves with indicator dials,** manual and automatic, for control of flow to oil burners covered in 2-color folder. Photos, performance data, specs incl. Catalog 707A, Hauck Mfg Co, 124-136 10th St, Brooklyn 15, N. Y.

50 **Synthetic rubber** O-rings, back-up rings and hydraulic packings as well as *Permadizing* process for rubber-to-metal bonding described in 2-color, 24-page catalog. Photos and full specs incl. Stillman Rubber Co, Dept C, 5811 Marilyn Ave, Culver City, Calif.

51 **Gates and valves** presented in 18-page, illustrated bulletin. Complete details and specs for slide gates, quadrant gates and other conventional units. Bulletin 1252, Stephens-Adamson Mfg Co, Aurora, Ill.

52 **Needle valves** for fine regulation of water, oil, gas, other fluids at up to 10,000 psi discussed in 2-color, 8-page folder. Photos, sectional views, complete specs incl. Catalog NV-1, Marsh Instrument Co, Skokie, Ill.

53 **Lubricated plug valves** and accessories of iron, brass, cast and forged steel described in 30-page catalog. Sectional views, sketches and complete specs incl. Catalog 53, Ohio Injector Co, Wadsworth, Ohio.

PRIME MOVERS & ACCESSORIES

54 **Diesel engines** described in series of bulletins covering continuous range from single-cylinder, 1.5-bhp engines to 8-cylinder, 910-bhp. Photos, sectional drawings, full specs included in each. Bulletins D4/4E, D22/2E, D45/E, D47E, D50/1E, D53E, D90E, D270/E.

Brief outline of history and development of Deutz diesel engines presented in series of illustrated booklets. Bulletins D30E, D46E, D140, D149E. Klockner-Humboldt-Deutz AG, Cologne, Germany.

55 **Hydraulic turbines and turbo-transmission** units presented in bulletin series. Each includes photos, sectional drawings, application data, full specs. Bulletins 1042, 1190e, 1192e cover turbo-transmission while 1140e deals with turbines. J M Voith Engrg Works, Heidenheim, Germany.

56 **Combustion gas turbine** power plants for mechanical drive applications discussed in 4-color, 24-page booklet. Load diagrams, dimensional drawings, performance curves and full engrg data incl. Booklet B-5859, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

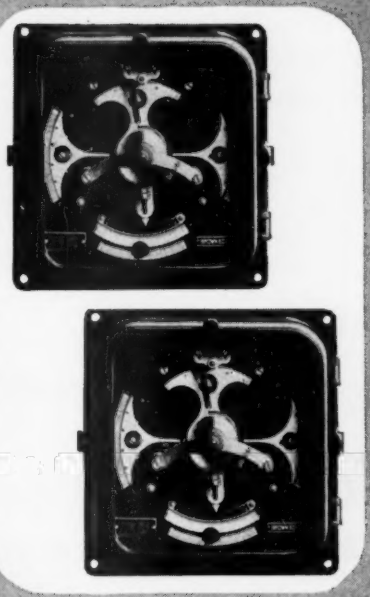
MISCELLANEOUS

57 **Human engineering** and its advantages throughout industry discussed in 8-page booklet published by Dunlap and Associates, Inc, 331 Madison Ave, New York, N. Y.

58 **Research in energy** and fuels described in 24-page, fully illustrated booklet published by Battelle Memorial Institute, 505 King Ave, Columbus 1, Ohio.

59 **Designing industrial products** for both function and appearance in meeting required standards of performance, size, weight and cost discussed in illustrated folder published by Designers for Industry, 2915 Detroit Ave, Cleveland 13, Ohio.

NO MAINTENANCE for 28 YEARS...



• • • is the case history of two Brown Boveri Generator Voltage Regulators installed in the Municipal Hospital of Springfield, Mass., in 1925. Over the years, these regulators gave trouble-free performance, requiring no maintenance whatsoever other than periodic dusting. Returned to the Brown Boveri shops this year for servicing for the first time, the units needed merely the replacement of the jeweled bearings.

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GENERATOR
VOLTAGE REGULATORS

are built as long term investments in dependable service. Many Brown Boveri Regulators have been in service for two decades or more and they are . . .

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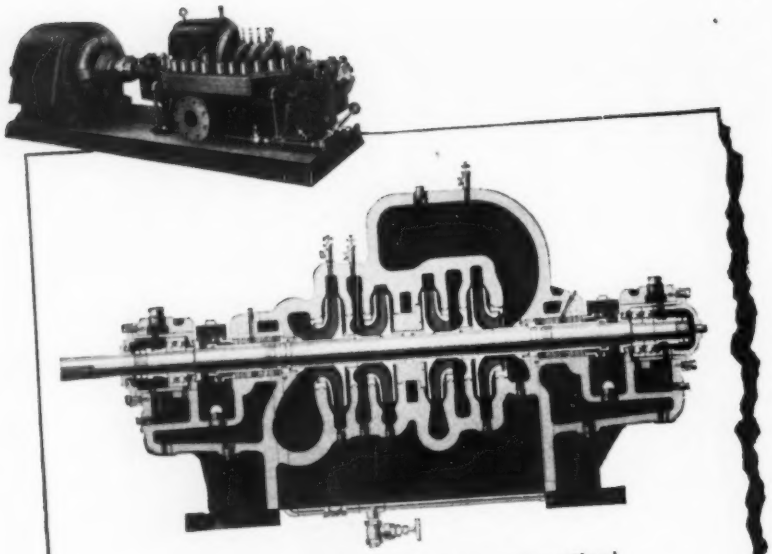

Goulds Fig. 3360 Multi-Stage single suction centrifugal pump for boiler feed and other high pressure pumping services. Capacities to 2250 G. P. M. Heads to 3050 ft.

Get trouble-free high pressure pumping service

If you are looking for high efficiency, low maintenance boiler feed and other pressure pumping services, it will pay you to investigate Goulds Fig. 3360 pumps. Power Engineers like them because they provide:

1. HYDRAULIC BALANCE—Single suction impellers are placed back to back in pairs with suction openings opposed to each other. End thrust created by one set of impellers is counter balanced by end thrust of opposite set.

2. STUFFING BOX PRESSURE RELIEF—Stuffing boxes at both ends of pump have an inner sealing pressure relief chamber.

3. MAINTAINED EFFICIENCY—MINIMUM INTERNAL LEAKAGE—Leakage from high pressure to low pressure side is minimized by long center casing bushing with liner.

4. ASSURED ALIGNMENT—Bearing housings are cast as integral part of lower half casing. Double tongue and groove locks prevent rotation of rings and bushings.

5. EASY ACCESSIBILITY—Removal of top half casing permits easy removal of rotating element without disturbing piping connections.

6. INTERCHANGEABILITY OF PARTS—Close machining and rigid inspection guarantee interchangeability of parts. Save on inventory and down time.

For detailed description, specifications and dimensions, contact your nearby Goulds representative or write for Bulletin 722.5.

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My Biggest Boner

► ONE OF MY FIRST JOBS was hand firing boilers in a local textile mill. The first day, after being shown around the plant, I started to shovel coal energetically. It wasn't long before I was sweating and looking for the drinking water. Though I'd seen the previous fireman go into the next room to a cooler there seemed little wisdom in going so far when there was a hose and water right near the boilers.

So every now and then I took a drink from the hose. By the end of the shift my stomach had begun to ache and I felt quite sick. Next day I went through the same routine with the same results.

It wasn't until the third day that the Chief, passing the boiler room and seeing me drink from the hose, let out a yell. He told me the water coming from the hose was pumped from a nearby canal and used only to wet down ashes or wash the floor.

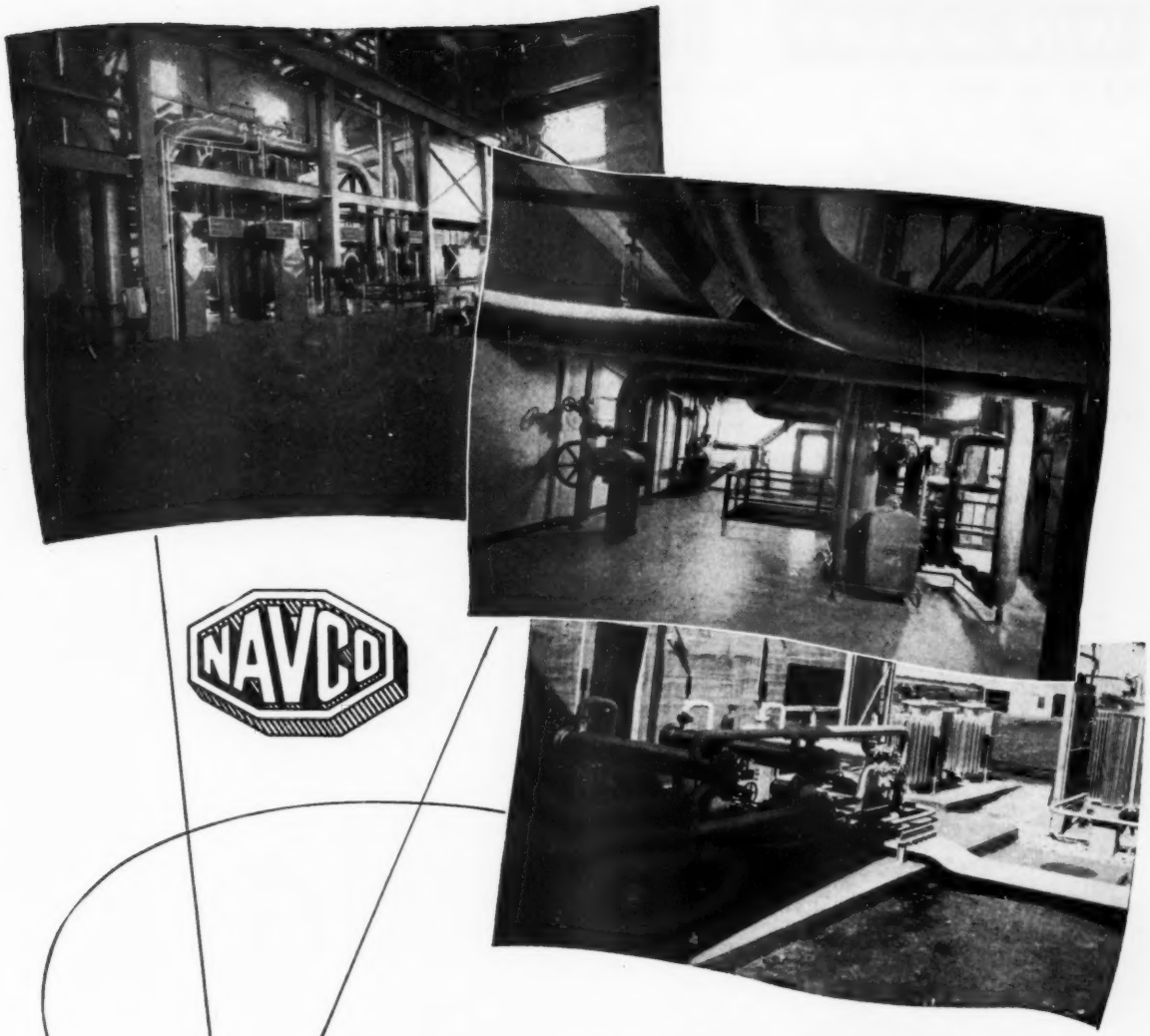
I spit it out in a hurry and ever since then have been doubly cautious to see that my men have a good supply of drinking water placed where it is easy to see and reach at all times.

D R TESSIER

Indian Orchard, Mass.

• What is your "biggest boner"? We'll pay ten dollars for each one we publish.

An Industry Advisory Committee on equipment cooling systems has been formed to assist the Air Force in overcoming the problem of extremely high temperatures encountered by supersonic aircraft and missiles. Immediately beyond the speed of sound lies a temperature barrier created by aerodynamic heating. The aircraft temperature rises from 230F at 1000 mph to 800 F at 2000 mph despite low air temperatures.



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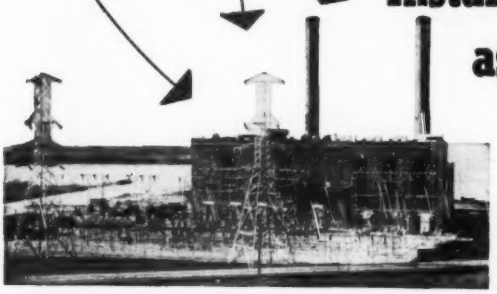

FOR almost half a century Navco has specialized in the fabrication and erection of Piping Systems for the highest operating conditions.

The "first" base load Central Station Piping System operating at 1350 lbs. and 900° (back in '30)—the "first" carbon moly to be used in a complete Steam System of Central Station Piping—one of the "first" field x-rayed systems of Steam Piping and one of the "first" Piping jobs to serve a 1,000,000 lb. per hour boiler are among some of the many Navco installations.

Consult Navco for your next Piping job.

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maximum capacity, better efficiency, when all your men are equipped with their *own* necessary tools for immediate use, any time.

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valuable man hours when your men are made to walk to a distant point in the plant for *needed* tools.

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BOOKSHELF

PIPEFITTERS HANDBOOK. (1953). *By Forrest R Lindsey. 4x7, 282 pp, fabrikoid, $6.00. The Industrial Press, 148 Lafayette St, New York 13, N. Y.*

This handy book is designed to help fitters solve pipe-bending, offsetting, mitering, layout and other problems in shop or field. It contains many tables and illustrations for setback, length of bends, offsets, mitered joints, fittings, valves, etc. Mathematical data, 47 pp, and an eight-page pipefitters dictionary section make the book more useful for those unfamiliar with fitters work. Though aimed at the man doing the actual fitting, this book should interest piping designers and estimators, too.

TRANE AIR CONDITIONING MANUAL. (1953). *9x11, 390 pp, illust, cloth, $5.00. The Trane Co, La Crosse, Wis.*

Revised 17th printing contains much new material over last revision. Thoroughly practical, the book shows how to apply engineering fundamentals to the design of air-conditioning systems. Derivations of fundamental ideas are clear and easy to understand. A number of problems at the end of each chapter permits the beginner to test his new knowledge.

MANUAL ON INDUSTRIAL WATER. (1953). *Prepared by ASTM Committee D-19 on Industrial Water. 6x9¼, 344 pp, illust, cloth, $4.25. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This is intended as a reference for three types of users: executives and plant designers, individuals doing work with operations using industrial water, and analysts, instrument operators, engineers and consultants.

It offers information on the influence of water on industries, serves as a guide to the nature of water planning, and gives specific instructions for making various tests of water. The eight chapters include use of water in industry, difficulties caused by water, composition of water and water-formed deposits, treatment, sampling, analysis, etc.

Every engineer using water in boilers or process should have a copy of this book for reference.

DIESEL ENGINEERING HANDBOOK. (1953). *Edited by A B Newell. 6x9, 827 pp, illust, tables, cloth, $7.50. Diesel Publications, Inc, 192 Lexington Ave, New York 16, N. Y.*

Eighth edition of this handbook starts with engine fundamentals and advances to the various elements of design and construction. Some subjects such as injection receive comprehensive treatment, the discussion covering several chapters. Other elements are discussed in more general terms.

Later chapters cover stationary diesel plants, marine installations, and specific engine makes and types. Tabulated specifications supplement data on makes and models. Though well-illustrated throughout,

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A TYPE FOR EVERY USE!
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Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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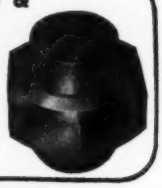

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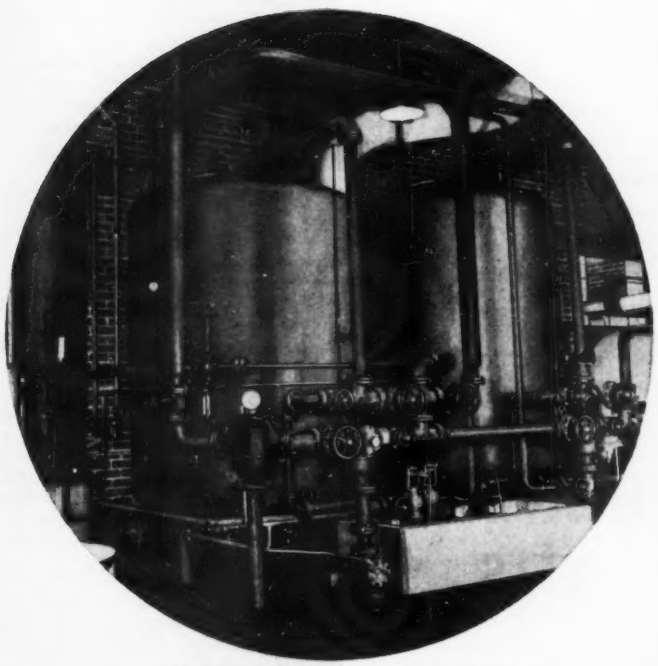
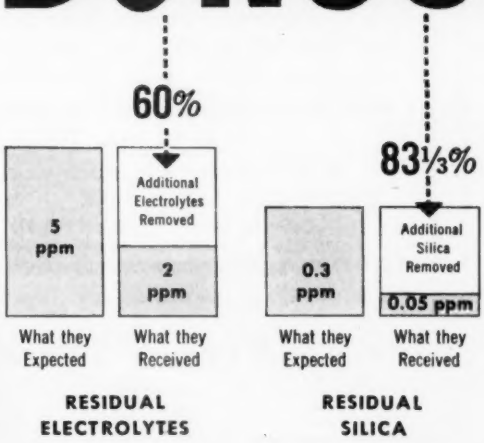
CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

How this Demineralizer delivered a BONUS





GRAVER EQUIPMENT IN THIS PLANT

Two-bed demineralizer to treat 300 gpm of boiler feed make-up. Total capacity of softening plant per regeneration: 640,000 gallons, using Gravex ion exchange material. J. E. Sirrine Co., Consulting Engineers, selected Graver demineralizing equipment.

If you wanted to reduce the total electrolytes in your raw water to *5 ppm*, and the demineralizing plant you installed actually reduced the electrolytes to *less than 2 ppm*, you'd have good reason to consider it a good investment.

And if, in addition, you expected the plant to reduce silica to *0.3 ppm*, and found that the silica was actually being reduced to *less than 0.05 ppm*, you'd have still more reason to consider that your demineralizer was delivering quite a bonus.

That's exactly what happened at the Riegel North Carolina Corporation's plant at Acme, N. C., without increasing the planned regenerant dosage. No wonder both the Company and its consultants consider the results very satisfactory.

To be sure of a completely satisfactory water conditioning plant for your own needs, get the benefit of Graver's 40 years of specialized experience.

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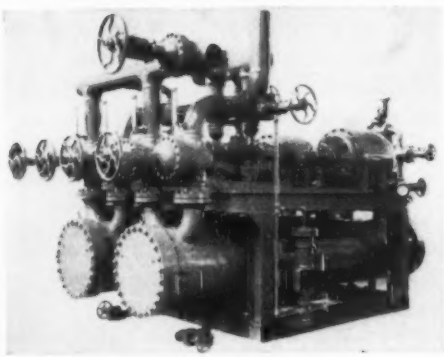
ALTON, ILL. U.S.A.

LOCKETT FUEL OIL PUMPING AND HEATING SETS



The compact, high-pressure Unit illustrated here was built for a large Utility Station in the South West. It consists of two Motor-driven Pumps and two Shell - and - tube - type Oil Heaters mounted on a single frame. Each pump is designed to handle a capacity of 55,000 pounds per hour of bunker fuel oil, against 300 P.S.I.

Custom Built

For almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built, Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump-and-heater is suitable for the full rated capacity of the unit; the second pump and heater are spares. Lockett supplies everything, complete. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.

Contracting Mechanical Engineers

NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

More BOOKSHELF

Begins on page 254

there are some line drawings and charts that could be improved by redrawing before reproduction.

ILLUSTRATED PETROLEUM DICTIONARY AND PRODUCTS MANUAL. *By the Editorial Staff of the Petroleum Educational Institute. 502 pp, 9x5½, $8. Petroleum Educational Institute, 9020 Melrose Ave, Los Angeles 46, Calif.*

This manual follows the alphabetical-dictionary technique throughout and provides term definition specifically for those lacking technical background in petroleum. Quite complete (possibly even straying from the petroleum industry at certain points), the book—through use of terse text and abundant illustrations—attempts to cover both technical and semi-technical aspects of the industry.

This publication should be of considerable value as a quick reference for sales people who want a talking acquaintance with the subject. Apparently most, if not all, of the illustrations and data are based on publications from oil companies and others related to the petroleum industry.

Walker L Cisler, president of Detroit Edison Co, has been elected president of the Atomic Industrial Forum, Inc. Alfred Iddles, president of Babcock & Wilcox Co, and Dr Frederick L Hovde, president of Purdue University, have been elected vice-presidents.

Extensive drying facilities will be built near Rockdale, Texas for large-scale use of lignite as a major power source in the smelting of aluminum. This will represent the first extensive use of lignite for industrial power production. The dryer units, in groups of three, will be ready for operation toward the end of this year.

Eight new portable extreme-temperature conditioning boxes will soon be on the firing line at Jefferson Proving Ground, Madison, Indiana. Designed to store ammunition at temperatures ranging from —100 F to 200 F, the huge boxes will aid the Army in studying temperature effects on ammunition.

The 3350-lb chambers, 60x48x108 in., operate from a 115-v, 20-amp power supply. Automatic controls maintain desired temperature conditions. Dry ice may be placed in containers located in the rear partition of the chamber and an automatic damper regulates the circulation of air around the ice. The chamber will reduce the temperature from 90 F to —70 F in 45 min and will hold this temperature for 18 hours without additional ice.

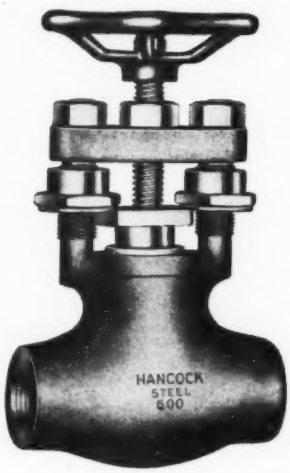
Thermostatically-controlled electric heaters are also located in the rear partition of each chamber. Air circulates around the heaters as in the case of the dry ice. The main chamber doors are engineered so as to open freely in case of an internal explosion, and all materials are non-inflammable. Each chamber is so constructed that vibration or shock from gunfire will not affect operation.

10 FACTS YOU SHOULD KNOW

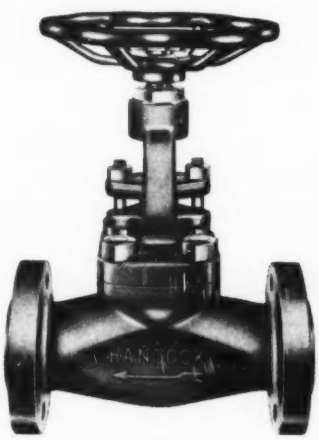
ABOUT

600# HANCOCK STEEL WELDVALVES

GLOBE AND ANGLE



600# HANCOCK STEEL WELDVALVES, in globe and angle types, are built for all pressures up to 850 psi at 750°F — O.W.G. 2000*, 100°F. **Screwed and socket weld ends** available on sizes from ¼" through 2". **Flanged ends** on sizes from ½" through 2".



You can't buy another 600# valve that can do as good a job as these Hancock Weldvalves. Their unique construction, precision manufacture, and high quality components eliminate or neutralize all major sources of trouble. Convince yourself. Study these reasons why 600# Hancock Weldvalves serve better and longer:

1. **BONNET JOINT ELIMINATED.** No gasket to blow. No bonnet joint to leak.
2. **NO SEAT RING JOINT TO LEAK.** Lifetime integral seat has a 420 Brinnel cobalt chromium tungsten alloy facing. Disc is 500 Brinnel stainless steel. Both are accurately finished, perfectly aligned —won't leak. No wire drawing, galling, steam cutting, erosion or corrosion.
3. **PACKING THAT'S "TOPS".** Ideal for temperatures up to 850°F. Made of finest quality long fibre yarn. Plastic core is extruded when braided wire inserted jacket is woven around it. Binder in the core is highly compressed—packing shrinkage is only 5%. Zinc dust inhibitor helps prevent stem pitting. Repacking is simple—packing gland flange can be swung out of the way, leaving both hands free to work.
4. **NON-PITTING STEM.** 300 Brinnel chrome stainless steel—not affected by electrolytic action.
5. **NON-FREEZING BALL RACE JOINT.** Stainless steel ball bearing stem-to-disc connection assures even load distribution, easy operation, corrosion resistance, longer service.
6. **CORROSION RESISTANT BACK SEATING.** Stuffing box can be shut off around the stem with the valve fully open.
7. **NO NON-WORKING THREADS ON STUDS.** All studs are chromized—equivalent to 18-8 stainless steel. Non-corrosive—always workable.
8. **BUILT EXTRA STRONG TO LAST.** Carbon steel body is suitable for 700# and 850°F. service. Maximum use of welding adds strength. Upper structure is far more rugged than conventional designs.
9. **EASY TO INSTALL IN TIGHT SPOTS.** Space-saving compactness permits close alignment of piping with near structures. 30 to 60% less weight makes handling easier. Flanged ends simplify installation of sizes ½" and larger where space is extremely limited. Packing glands can be readily pulled tight in close quarters.
10. **ECONOMICAL TO MAINTAIN.** Fewer parts, the finest quality packing, repacking ease, every practical use of stainless steel, corrosion resistant treatment of the entire valve—all assure low-cost, long-life service.

All these advantages are yours when you invest in 600# Hancock Steel Weldvalves. Yet they are priced right in line with ordinary valves. Your Hancock Valve Distributor is as close as your telephone. Get complete specification and operational data — phone him today.

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A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

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Ferri-Floc WAY IS A BETTER WAY!

You Can Expect These Advantages With Ferri-Floc-

1. Rapid Floc Formation	5. Bacterial removal
2. Taste and odor control	6. Manganese and Silical removal
3. Color removal	7. Turbidity removal
4. Ease of operation	8. Economy

Ferri-Floc has the ability to coagulate waters and wastes over wide PH Ranges and will provide excellent floculation in softening systems.

SULPHUR-DIOXIDE HIGHEST QUALITY SO_2

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER TC SULPHATE

COPPER SULPHATE will control about 90% of the micro-organisms normally encountered in water treatment plants more economically than any other chemical.

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APPOINTMENTS

Corporation Executive Changes

Johnston Pump Co: Kenneth G Lundie, from vice-president of the parent company in Pasadena to president of Johnston Pump Companies of New Mexico and of Fresno. **American Gas & Electric Service Corp:** Donald C Cook, vice-president and assistant to the president. **Federal Electric Products Co:** J S Thompson, A A Browne and T Challoner, members of the board of directors; all are top executives in Pacific Electric Mfg Corp.

Operations Executive Changes

Nordberg Mfg Co: J D Grace, from manager of advertising and sales dept to manager of the screen dept. **Borg-Warner Corp:** A P Emmert, from president of Warner Gear Div to general manager of Detroit Gear Div. **Detroit Edison Co:** Lemore W Clark, from head of Underground Lines Dept to assistant manager of operations.

Air Reduction Sales Co: H L Ingram Jr. from Washington special representative to manager of Technical Development Dept. **Sprague Electric Co:** Dr Wilbur A Lazier, vice-president and technical director. **Texas Eastern Production Corp:** Harry R Moseley, Gulf Coast division superintendent. **Ebasco Services, Inc:** Jack McKamey, project manager of the Littleton Hydroelectric Development. **St Paul Hydraulic Hoist:** Warren A Blossom, from field engineer to service manager.

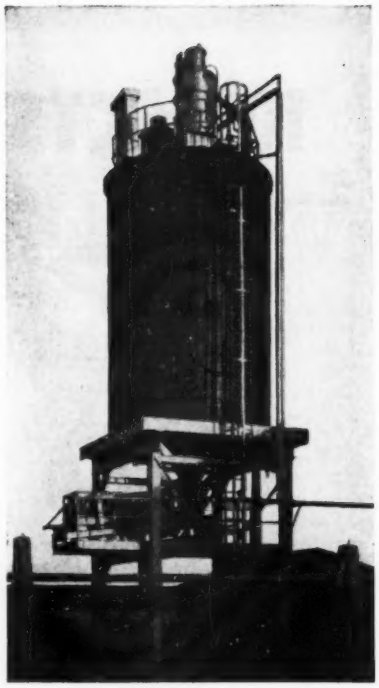
Engineer Changes

Allis-Chalmers Mfg Co: Edmund F Volker, application engineer in blower and condenser section; Norman P Sutton, assistant engineer in switchgear dept; Theodore Shamshoian, superintendent of erection in service section. **Trane Co:** Carl W Larson, air conditioning and heating development in Products Engrg Dept. **Aluminum Co of America:** Donald I Bohn, from chief electrical engineer to head of Special Electrical Development Engineering; Louis N Grier, from assistant chief to chief electrical engineer.

Texas Eastern Production Corp: Jack R Fraser, from division engineer to chief petroleum engineer. **National Coal Assn:** Glynn L Coryell, from the Washington staff to the engineering dept staff. **General Dynamics Corp:** Raymond E Scheubel, from chief draftsman for Wilcolator Co to tool and design specialist, Electro Dynamic Motor and Generator Div.

New Sales Managers

Trane Co: A James Hackl, Dallas office; William C Dackis, process heat transfer sales dept; James R Whalen, convector sales dept; Ted W Ernst, coil sales dept; Lloyd E Eater, fluid cooler div of heat transfer sales dept. **Baldwin-Lima-Hamilton Corp:** E H Schoonmaker, St Louis District Office for the Eddystone Division.



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MEANS

Dependable Low Cost Ash Removal

A survey of your plant by a NATIONAL engineer may reveal that ash removal costs are cutting your profit margin. A survey will cost you nothing . . . may very well boost your earnings.

NATIONAL PNEUMATIC STEAM ASH REMOVAL SYSTEMS

add to the efficiency of your plant in two ways —

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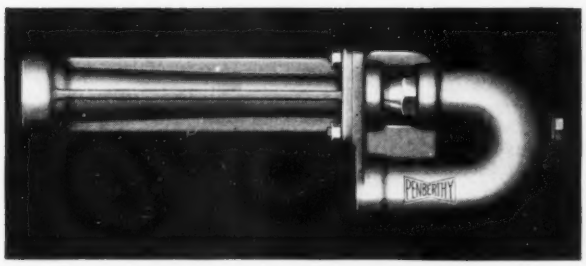

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AUTOMATIC INJECTORS

Penberthy injectors are the accepted method of assuring a dependable supply of feed water, at lowest cost, to oil field and other firebox and portable boilers. They are being used increasingly for standby service on many large boilers. Easily installed, they require little or no attention.

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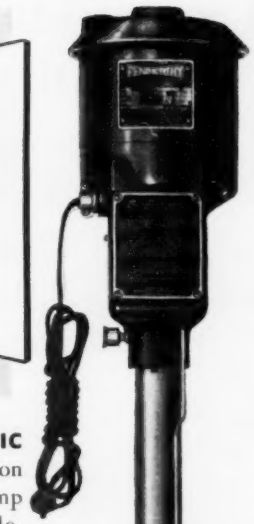
...are among the other Products by Penberthy which can serve you in your operation. Why not write for literature detailing specifications and advantages. Ask, too, about the engineering service which Penberthy is providing for many prominent concerns in your industry.



AUTOMATIC ELECTRIC SUMP PUMPS—Corrosion resistant Penberthy sump pumps are correctly designed and made of copper and bronze throughout. There are 7 sizes, 3 models equipped with trouble-free features to give years of economical, dependable service.

LIQUID LEVEL GAGES—Penberthy makes a complete line of gages and valves for every type of application. 70 years of engineering experience is on hand to accommodate your particular requirements. You can always be assured of complete cooperation and reliable product service for any pressure...in any length.

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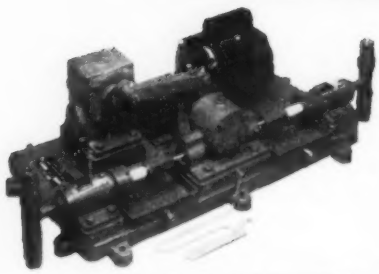
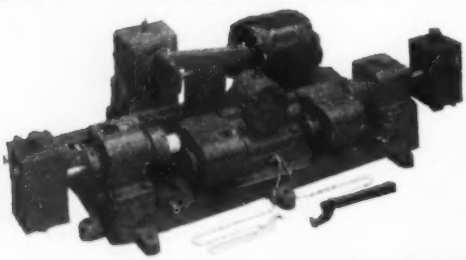


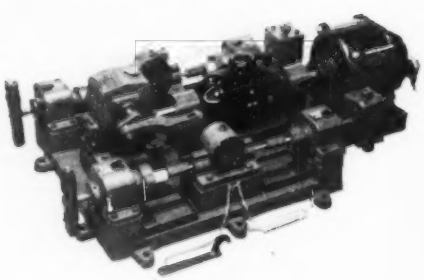
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



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"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

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Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2369 W. Nelson St., Chicago 18, Ill.

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metering and proportioning pumps

Also Manufacturers of:
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FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

More APPOINTMENTS

Begins on page 258

General Electric Co: Apparatus Sales Division, Michigan District—W A Mosteller, sales; F T Scott, product sales; H H Handorf, chemical steel and large users; E I LeBaron, Flint, Mich. office. East Central District—E H Howell, sales; R C Hardy, industry sales; G J Clark, apparatus product sales; C J Miller, component product sales; R E Boyle, Cleveland office.

Graybar Electric Co: S M Cook, Milwaukee branch replacing R J Harkins, retired. Johns-Manville Corp: William S Hough, Chicago Industrial Products Division. **Combustion Control Corp:** John M Englisby, Eastern Region.

Sterling Electric Motors, Inc: Earl J Phillips, the new Chicago sales office. **Anaconda Wire & Cable Co:** Robert T Shields Jr, Dallas district. **Appleton Electric Co:** E A Hakanson, Chicago district. **New York Belting & Packing Co:** Carl G Link, Great Lakes Region; Wenzel A Lindfors, nationwide sales. **National Carbon Co:** J R Johnstone, carbon products dept.

New Sales Engineers

Reliance Electric & Engineering Co: Donald L Peterson, Cleveland district office; David H Rush, Buffalo district office; John E Harger, Detroit district office. **Allis-Chalmers Mfg Co:** Douglas M Norris Jr, Hartford office; Maurice F Corcoran, Cleveland office. **Trane Co:** Roy L Smith, Philadelphia office; James J Callahan, Newark office.

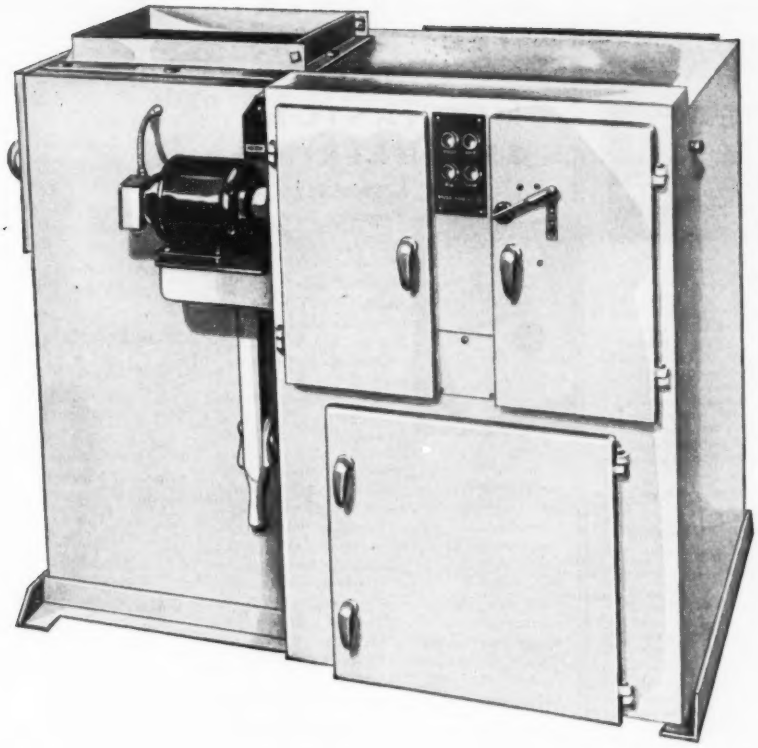
General Electric Co: Walter F Brown, Chicago silicone products dept. **Dravo Corp:** Robert Barefoot, Cleveland office; John Schuster, Detroit office; D H Felix, Chicago office; E G Counselman, metropolitan New York territory. **U. S. Hoffman Machinery Corp:** Leonard E Petzinger, Cleveland area.

General Dynamics Corp: William G Hill, New England territory. **North American Philips Co, Inc:** Philip I Wolf, Research & Control Instrument Division. **Flexible Steel Lacing Co:** Howard Gill, southeastern region. **Automatic Transportation Co:** John W Cannon, John J Connell Co, St Louis representative.

New Distributors

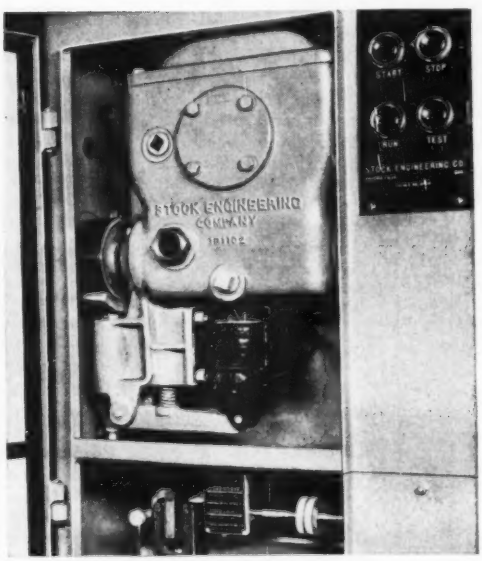
For **Worthington Corp:** Poe Co of Detroit, sale, installation and service of Worthington's line of vertical turbine pumps. For **Graybar Electric Co, Inc:** display room and warehouse at 1140 N Irwin Ave, Green Bay Wis, under management of John W Peterson. For **General Electric Co:** Northern Commercial Co of Alaska, apparatus products sales and renewal service.

For **Johnson Service Co:** branch office in La Crosse, Wis. under management of E K Edwards, formerly of the Milwaukee office. For **General Gas Light Co of Kalamazoo:** Keps Electric Co of Pittsburgh, tri-state distribution of Humphrey Gas Heaters. For **Libbey-Owens-Ford Glass Co:** Moncrief-Lenoir Mfg Co of



The Boiler With S-E-Co. Coal Scales

Close-up showing reducer, brake, and easily accessible tare and compensator adjustment mechanisms.



can squeeze the last BTU from each pound of coal because its operator knows exactly how many pounds of coal have been burned over any time interval.

Not only is the S-E-Co. Coal Scale accurate to ¼ of 1%, but it is completely modern in design — offering the maximum in reliable operation. Independent thinking and foresight have incorporated the following exclusive features as standard equipment in the S-E-Co. Coal Scale:

1. Counter that is electrically operated and, therefore, completely reliable and trouble-free. Easily mountable on remote central control station, if desired.
2. Unrestricted scale inlet with vertical skirt sides on feeder and with no baffles or other restrictions hindering coal flow through the scale.
3. Molded endless belt on self-contained feeder frame that can be removed from scale housing with unmatched ease and speed.
4. Standard frame motor with completely separate brake and gear reducer.

Write today for further details contained in our Coal Scale Bulletin or for a local representative to call on you and discuss our scale and other equipment.

Specialists in Bunker to Pulverizer or Bunker to Stoker Equipment

STOCK EQUIPMENT COMPANY
745P HANNA BUILDING CLEVELAND, OHIO

Control Overhead Valves Easily with...

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Operate any out-of-reach overhead valve with ease — right from the floor! Babbitt Adjustable Sprocket Rim with Chain Guide makes any valve instantly accessible — simplifies overhead pipe layouts, prevents steam waste, provides low-cost accident prevention, too. Easily installed, ready for operation in a few minutes.

- **Saves money on fuel & steam**
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- **Positive, efficient valve control**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple, quickly-assembled parts.

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Here at last is a book which presents, in compact form, the essential theory and practice used in the *performance testing* of such equipment as engines, pumps, compressors, and combustion and heat transfer apparatus.

Sweeney's book provides a working understanding of the *why's* behind the *how's*: it gives the theoretical background behind measurement principles and errors, as well as the principles upon which the design and operation of instruments are based. It gives seldom found methods for estimation of error in temperature measurement, and presents interesting possibilities for instrument design projects which have not been offered in other books. Application of theory to practical problems encountered in testing work is stressed throughout.

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More APPOINTMENTS

Begins on page 258

Houston; Midland Engrg Co of Indianapolis; Dodge Engrg Co of Detroit; D M Peffley & Son, Inc of Dayton; R L Moore Pipe & Boiler Covering Co of Raleigh, N. C.

For **Magnatran, Inc:** J J Costello Co of Boston, exclusive New England transformer distribution. For **Gregory Industries, Inc:** branch warehouses at Atlanta under Fred Millenbaugh, at St Louis under Donald Duffey and at Denver under Vincent G Probst.

New Representatives

For **Elgin Softener Corp:** Stanley E Kerr, southeastern Texas territory. For **Barber-Colman Co:** factory branch offices at Syracuse under K C Watson and at Jacksonville under D W Minick. For **General Electric Co:** George E Shepherd, northern New Jersey sales. For **Borg-Warner Corp:** A W Rose, Pacific Coast.

For **Combustion Control Corp:** Snyder Co, Inc of Odessa, Texas and Industrial Boiler and Equipment Co of Memphis, Tenn. For **Cleaver-Brooks Co:** Hathaway-McCartney Engrg and Supply Co of Denver. For **Farr Co:** Air Filter Sales & Service Co of Nashville. For **Atkomatic Valve Co:** A H Barbera & Co of Los Angeles, Irving Kahn Associates of Hartford and Wickersham, Petty and Co of Boston.

For **Hiab Crane Co of Sweden:** Versatile Hydraulic Crane Co, sales agents for 11 western states and Hawaii. For **Continental Fdry & Mach Co:** Power Economy, Inc of Kansas City. For **Poole Fdry & Mach Co:** Kramer Industrial Sales Co, Wisconsin-Iowa sales.

Recent Purchases

New York State Electric & Gas Corp: electric generating and other facilities of Eastern New York Power Corp. **Aeroquip Corp:** the Van Wert plant of Sterling Electric Motors, Inc. **Chicago Pneumatic Tool Co:** all assets of Jacobs Mfg Co of Conn.

Clark Equipment Co: full interest in Ross Carrier Co. **Fluor Corp of Canada, Ltd:** an interest in H G Acres & Co. **Chas T Main, Inc:** all business of John A Stevens, Inc. **Stonco Electric Products Co:** Lighting Products Div of M B Austin Co. **Sheldon Machine Co:** Sebastian Lathe Div of Cincinnati Metalcrafts, Inc. **Pyle-National Co:** all tools, dies, molds, machinery and equipment of M B Austin Co. **Set Screw & Mfg Co:** facilities for manufacture and sale of the line of Offset Self-Locking Screws of Shakeproof Div of Illinois Tool Works.

New Names

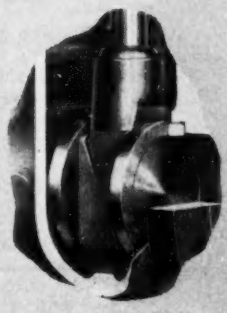
Westinghouse Electric Corp: former northwestern district renamed Mid-America Region with headquarters in Chicago **Rockland Light & Power Co:** Hudson Plant at Tomkins Cove renamed Lovett Plant in honor of late president. **Callahan Zinc-Lead Co, Inc:** American Ventilating Hose Co, a subsidiary, now Flexaust Co.

DARLING VALVES

2 VALVE PRINCIPLES

that save money for DARLING Cast Steel Valve users!

1 ***Darling Fully Revolving Double Disc, Parallel Seat Gate Valve.*** **Just four simple working parts . . . two interchangeable, no-pocket discs and two husky wedges. Maintenance is easier, assembly is foolproof, and tight seating is assured.**



2 ***Darling Slotted Wedge Type Gate Valve.*** **Notice the unique center slot which permits wedge to seat under compression and adjust to valve seats as valve body expands and contracts.**

Select the DARLING Valve to meet your specific needs

WHETHER you select the fully revolving double disc, parallel seat type . . . or the slotted double grooved wedge type . . . you'll have a Darling gate valve with outstanding features that are minimizing down time and cutting maintenance costs on job after job.

Check cutaway view No. 1. This famous Darling self-adjusting, revolving disc parallel seat gate valve is rated by users as the most trouble-free, best performing gate valve obtainable. Its simple, efficient design assures *automatic* compensation for valve body distortion. In addition, wear on valve parts is *uniform*, which means much longer service life.

Now take a close look at cutaway view No. 2. This Darling valve will do everything that an ordinary solid wedge valve can do . . . *and more.* The wedge is slotted to assure better seating under valve body expansion and contraction. Tight closure and easy operation are assured, and there is far less wear on wedge faces and seats. *Also,* the *double* grooves, with *twin* guide ribs in the valve body, provide twice the usual bearing area. Canting of wedge caused by line pressure is thus eliminated, preventing damage to the downstream seat.

You'll be wise to get all the facts about these two types of money-saving Darling cast steel gate valves before you decide on any valve. Write today for general literature, or request information on your specific valve needs.

NOTE: Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

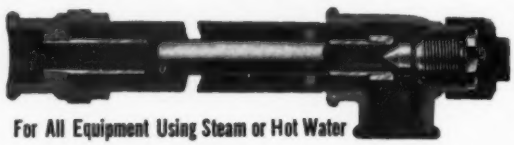
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Another Large Firm Adopts

$35 NICHOLSON TRAPS AS TEMPERATURE CONTROLS

Because they serve effectively as temperature controls as well as steam traps, and cost only about $35, Nicholson expansion steam traps are being increasingly installed in place of temperature regulators. A large processor recently installed these Nicholson units on outdoor storage tanks after thorough tests showed a less than 2°F variation in outlet condensate temperature. Regulators had been costing them $110.00 to $200.00, with cost of a trap added.

Nicholson expansion steam traps are easily adjusted to pass condensate at any temperature below 212°F. Because there is only one moving part, remarkably low maintenance costs are being shown. Easily installed, usually without supports. Lengths, 9" to 40". Press. 0 to 250 lbs. Freezeproof.



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W. H. NICHOLSON & CO.

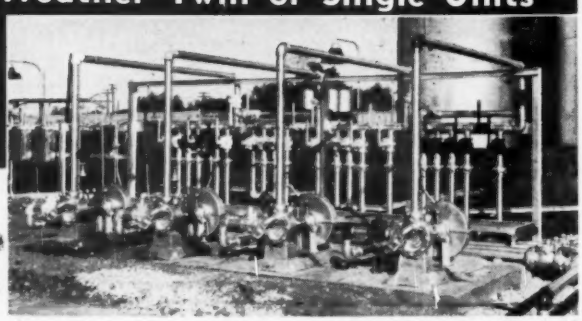
TRAPS · VALVES · FLOATS

SAVE with VIKING PUMPS

Use All-Weather Twin or Single Units

NO PUMPHOUSE NEEDED!

Eliminate a $750 to $1000 BUILDING



Mount Viking Pumps Outside . . . with No Protection Needed!

Either winter or summer, no protection is needed for Viking all-weather single or twin units.

Made for pumping all types of petroleum and chemical products from the very lightest to the most viscous.

Out door units add safety to the pumping job as well. No fumes to collect.

Neater and handier to use. No cramped quarters creating hazardous and unsightly conditions. Makes possible easier and less costly piping arrangements.

VIKING AN HONORED NAME IN PUMPING

In every way you save with Viking All-Weather pumps

Ask for bulletins B400W & SP223CW today.

See Our Catalog in SWEETS

VIKING PUMP COMPANY CEDAR FALLS, IOWA

More APPOINTMENTS

Begins on page 258

Institute Elections

American Society of Mechanical Engineers: Lewis K Sillcox, vice-chairman of the board of New York Air Brake Co, president succeeding Frederick S. Blackall Jr. **Societe Francaise des Electricians:** Dr Karl B McEachron, General Electric scientist and lighting authority, honorary member. **American Society for Engrg Education:** Ivan L Hill, associate professor of technical drawing at Illinois Institute of Technology, president of technical drawing division.

Awards

The **J James R Croes Gold Medal** to Paul Rogers of Rogers & Snitoff, Inc for his paper *Design of Large Coal Bunkers*. The **Thomas Fitch Rowland Prize** to E Montford Fucik, vice-president of L F Harza Engrg Co, for his paper *Petenwell Hydroelectric Project*.

Eighth annual **George Westinghouse Award** in engineering education to Edward F Obert, Northwestern University professor of mechanical engineering. **The Lamme Gold Metal** to I F Kinnard of General Electric Co, West Lynn, Mass. **Honorary degree** of doctor of engineering from Stevens Institute of Technology to August G Pratt, chairman of the board of Babcock & Wilcox Co.

Obituaries

Cyril G R Humphreys, 48, research engineer for Combustion Engrg, Inc, July 19.

Dr Theodore Whittelsey Sr, 85, former director of U. S. Rubber Co's research laboratory, June 26.

Dr Richard von Mises, 70, Gordon McKay Professor of Aerodynamics and Applied Mathematics at Harvard University, July 14.

Arthur R Borden, 53, manager of Detroit branch of Hagan Corp, July 6.

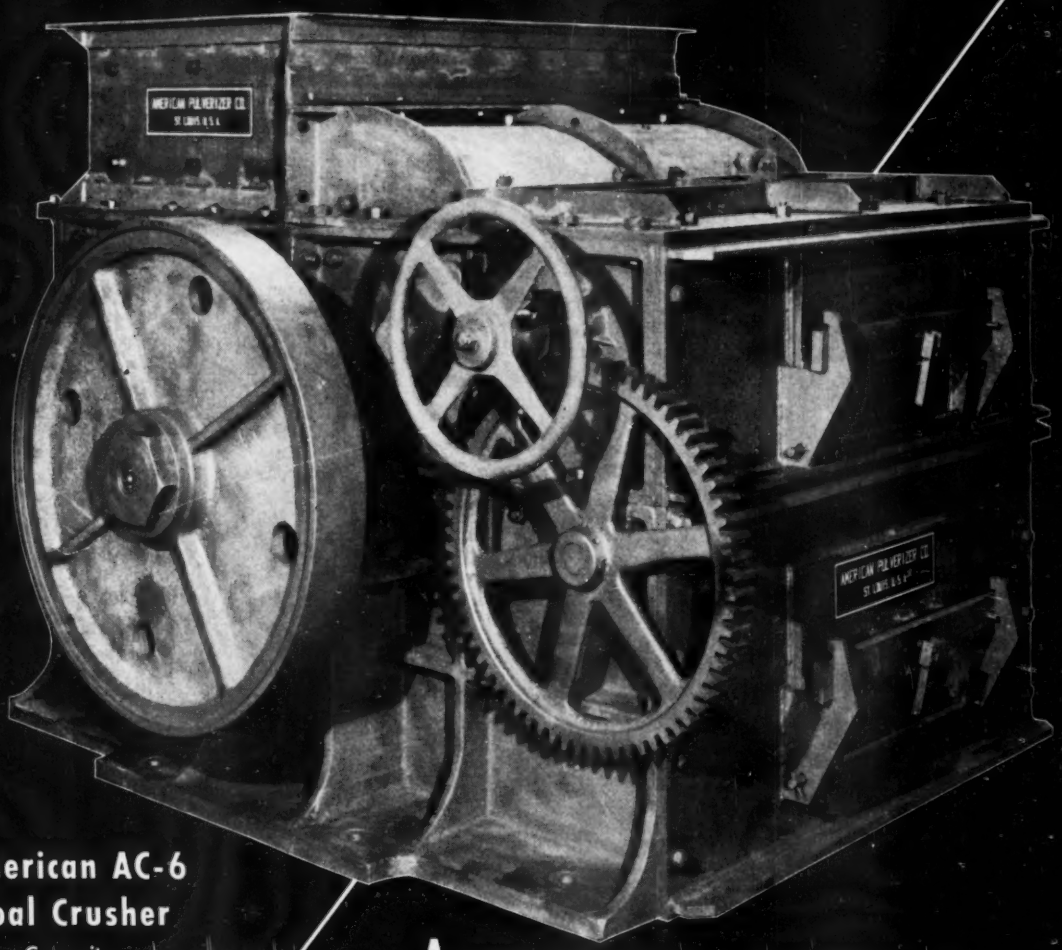
Forrest E Ricketts, 75, pioneer in the field of system protection of the electrical industry, July 3.

Fremont Leslie Lovett, 64, president of Rockland Power and Light Co, June 13.

Brown Boveri Corp, a Swiss firm, has received a $3,553,000 contract from the U. S. Atomic Energy Commission to build machinery for the Chief Joseph Dam in the state of Washington.

To get the contract, Brown Boveri underbid British Electric Co which, itself, had underbid Westinghouse Electric Corp and General Electric Co by $1 million. Although the Swiss firm will build the circuit breakers, $2 million worth of other items will be subcontracted to American firms.

QUALITY CLEAR THROUGH...



American AC-6 Coal Crusher

Capacity: 300 tons per hr. ROM to 3/4"

American Crusher quality is being constantly reaffirmed by case histories coming in from power plants, central stations and mines throughout the country . . . records which are proving beyond a doubt American's superlative performance and economy of operation. Here, for example, are the

Cost Surveys of 29 American Installations

Total Tonnage Handled.....61,000,000 Tons
Average Age of Crushers.....9.5 Years
Replacement Parts (Includes Standby Parts).....1/10 of 1¢ per Ton

THERE CAN BE NO BETTER PROOF OF QUALITY!

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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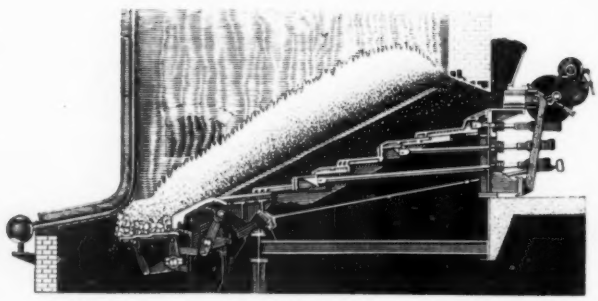

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5 ways better than aspirin

FIVE DIFFERENT HEADACHES have often been inseparably connected with stoker operation... and every one of them is eliminated by the modern, engineered AE Taylor Stoker.

CO_2? That's where Taylors give you unrivaled efficiency. *Quick load response?... complete dependability?* Taylor Stokers are completely tops in both respects. *Stack discharge nuisance?* Taylors meet the toughest municipal ordinances. With proper grate area, over 98% of the ash goes to the pit. *Burning versatility?* Properly proportioned, Taylors can and do burn coals satisfactorily from all over the U.S., and from Canada, England and the Continent as well.

Whether your new plant must generate 20,000 or 500,000 pounds of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us today for booklet telling the whole Taylor story.

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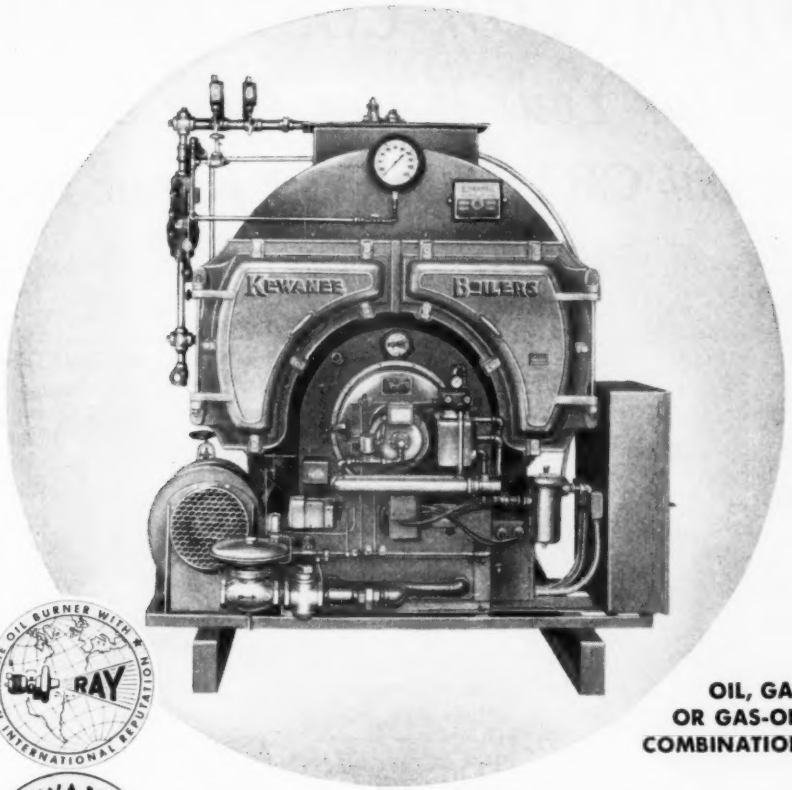
AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.



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OR GAS-OIL
COMBINATION

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BOILER-BURNER UNIT

Produce steam more economically, more efficiently, with the new Kewanee-Ray Boiler-Burner Unit. Use heavy catalytic residual fuel oils or light oils in combination with high or low pressure gas in a single unit!

New multi-stage, forced draft, secondary air control on the burner provides a constant velocity air stream to the combustion zone. Resulting high turbulence, high turndown ratio and high CO_2 content give you high combustion efficiency.

Quickly Installed . . . Simple to Operate. Matching connections are provided so that when the boiler and burner are brought together they can be easily connected with a minimum of field effort. A flip of the switch and the unit goes to work on either oil or gas. To change fuels, flip the switch again. *That's all.* Fully automatic operation throughout.

The Kewanee-Ray Boiler-Burner Unit is *complete.* Boiler, burner, all automatic controls and accessories as specified. No special foundation is required. All refractories are integrally mounted at the factory. And a built-in forced-draft fan eliminates need for high stacks.

For High or Low Pressure Steam or Hot Water Heating. High pressure units, for 1350 to 15,800 lbs. of steam per hour developing 39 to 456 horsepower at 125 and 150 psi. Low pressure units for 15 lb. steam or 30 lb. water rated at 1,313,000 to 15,300,000 btu.

The complete boiler is shipped from Kewanee, the burner including windbox and control panel from Ray...so each shipment can be timed to arrive when you want it. The boiler should be on the job site before the new plant walls are up. (Exposure to weather does no harm). The shipment of the burner can be delayed until the new building is enclosed. Arrival of unit in two separate shipments is another important advantage when Kewanee-Ray is specified.

RAY OIL BURNER COMPANY 1304 San Jose Avenue, San Francisco, California

KEWANEE-ROSS CORPORATION 105 Franklin Street, Kewanee, Illinois

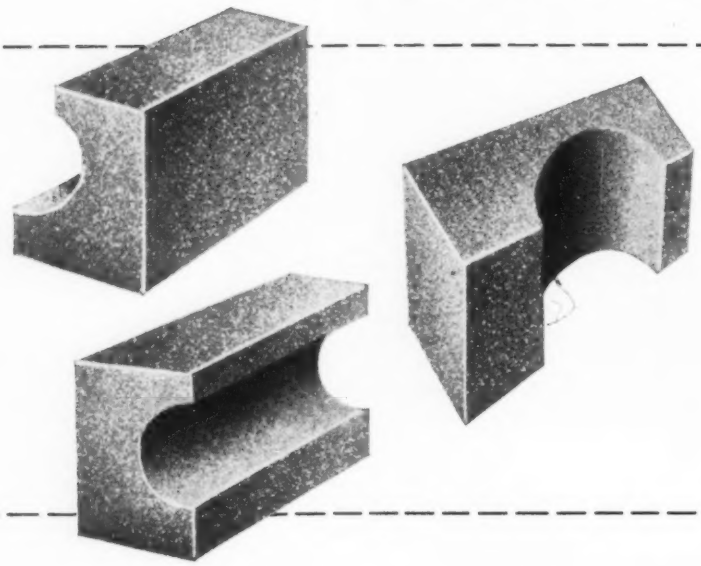
Please send me your 16-page KR-1031 Catalog giving complete description and specifications on your Boiler-Burner Unit.

NAME_____

ADDRESS_____

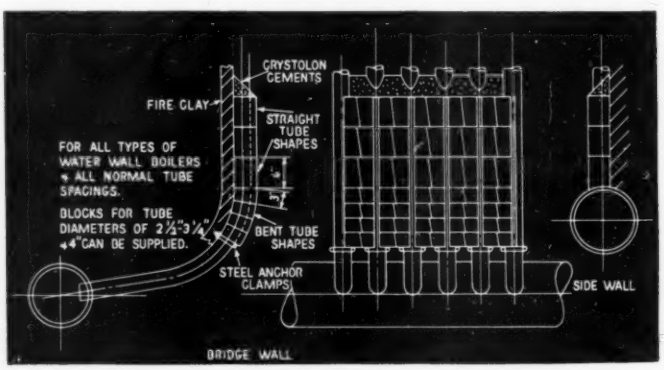
CITY_____ STATE_____

LASTING, LOW-COST PROTECTION
for Your Water Tube Boilers
with CRYSTOLON* Armor Blocks



Made Of Top-Quality Silicon Carbide, Norton CRYSTOLON Armor Blocks have the necessary refractoriness to withstand today's extremely high boiler furnace temperatures. Equally important is their high resistance to slag penetration and abrasion. Due to their high thermal conductivity, they promote even heat distribution, and afford maximum protection to tubes from localized heat generation and flame impingement.

Installation Is Easy And Inexpensive, thanks to the simplified design of CRYSTOLON Armor Blocks. Adjoining surfaces of blocks are tapered, for secure locking and to maintain intimate contact with the tubes. Available for both bent and straight tube sections, these blocks can be replaced entirely from the fire side of the boiler. They are laid dry, further reducing installation costs, and tubes require no cleaning or grinding, as when cast iron blocks are replaced. When small areas are to be protected against flame impingement, blocks can be held correctly in place by clamps fitted around the tubes.


CRYSTOLON CEMENTS
FIRE CLAY
STRAIGHT TUBE SHAPES
FOR ALL TYPES OF WATER WALL BOILERS & ALL NORMAL TUBE SPACINGS.
BLOCKS FOR TUBE DIAMETERS OF 2½"-3¼" & 4" CAN BE SUPPLIED.
BENT TUBE SHAPES
STEEL ANCHOR CLAMPS
SIDE WALL
BRIDGE WALL

Whatever type or make of water tube boilers you're using, you can depend on CRYSTOLON Armor Blocks for thorough protection and economy. For prices and full information, send data on tube diameters, tube spacing, radius of curvature in bent-tube sections, and dimensions of areas to be covered. Refractories Division, NORTON COMPANY, 448 New Bond Street, Worcester 6, Mass.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

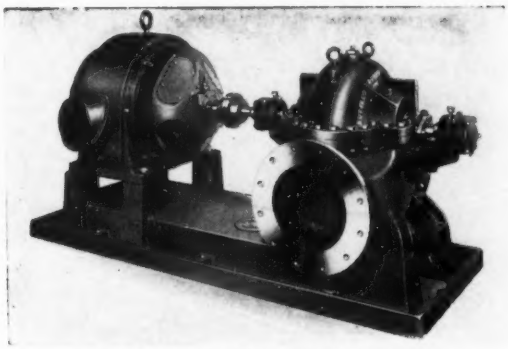
Making better products to make other products better

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

"Buffalo" *Tips on Better Pumping*

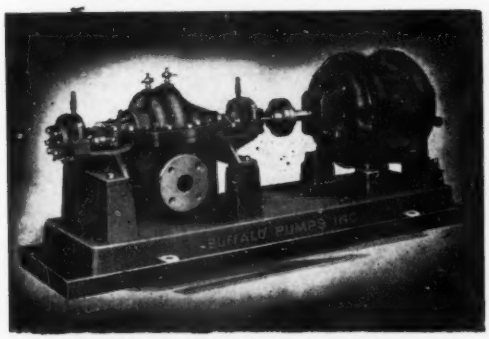
ADVANTAGES of 3 TYPES of CENTRIFUGAL PUMPS



"Buffalo" Type "SL" Double Suction Pump

DOUBLE SUCTION — EFFICIENT IN MOVING HIGH VOLUMES — IMPELLER SUPPORTED FROM 2 SIDES

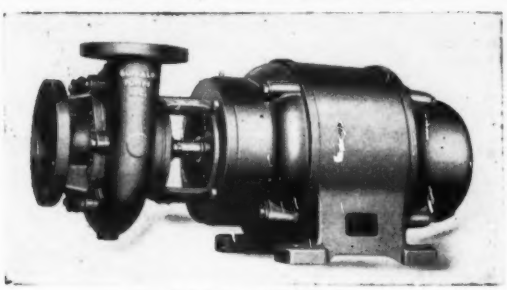
Taking in clear water from both sides of its enclosed double suction impeller, this "Buffalo" Type "SL" Pump is ideally suited to handling large volumes efficiently. Correctly formed water passages and perfect hydraulic balance add to its efficiency. Bearings on both ends of oversize impeller shaft assure maximum life. Large capacity range, from 10 to 10,000 gpm, for air washers, chilled water, humidifier, general service. Write for Bulletin 955-P.



"Buffalo" Type "RR" Two-Stage Pump

MULTISTAGE — EFFICIENT DESIGN FOR HIGH PRESSURES

"Buffalo" builds these durable, easy-to-maintain pumps in two and four stages for heads up to 1500'. Each additional stage develops additional pressure, a highly desirable feature for jobs such as boiler feed. Impeller receives ideal support from bearings on both sides. Horizontally split shell provides quick accessibility. For further details, write for Bulletin 980.



"Buffalo" Type "CCL" Pump

CLOSE COUPLED — SPACE SAVING — PERMANENT SHAFT ALIGNMENT

Available in all iron or special alloys, these husky single suction pumps are built as a unit—require no alignment during installation or afterwards. Each design—single suction, double suction, multistage—offers particular advantages. "Buffalo" builds all types, to give you the best possible pump for your job. Write for details on the full line.

"Buffalo" BUFFALO PUMPS, INC.

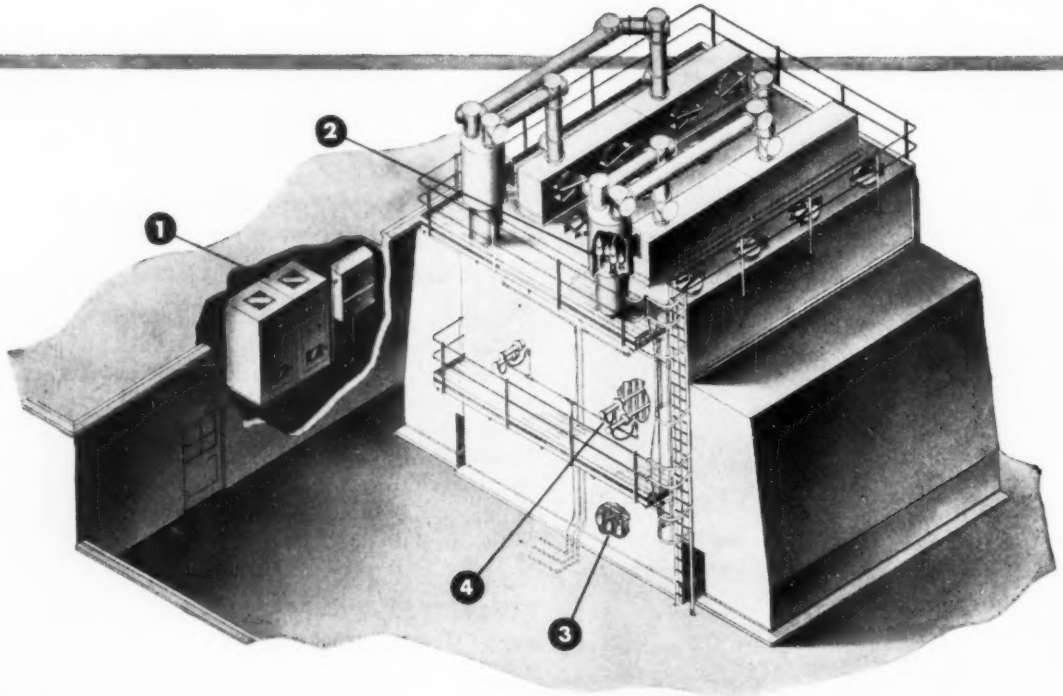
485 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

What's New in Electrical Precipitators?



FEATURES:	RESULTS:
1. Remote Control—Entire installation is operated by switchboard control from any convenient location.	**1.** Central control room operator can see all meters and operate all controls that determine optimum performance.
2. Low-cost Energization—Weatherproof high voltage transformer and electronic tube rectification equipment allow location flexibility and minimum power consumption.	**2.** Space conservation, short high voltage connection between rectifiers and precipitators insure compact, economical installation.
3. Unique Electrode Design—Plumb-bob discharge electrodes, individually weighted to remain taut, are uniformly positioned by a lower framework.	**3.** Discharge wires are kept perfectly aligned at all times for maximum overall precipitator performance.
4. Electronically Controlled Rapping—New magnetic impulse rappers are designed for continuous, sequential, smoothly regulated electrode rapping.	**4.** Eliminates stack puffs and produces increased overall efficiency.

Ask your Research Corporation representative to bring you up to date on the details of these and many other improvements that you will find in the modern Cottrell Electrical Precipitator.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
Bound Brook, N. J. • Grant Building, Pittsburgh 19, Pa.
122 South Michigan Avenue, Chicago 3, Ill.

RC1D

NO Reducing Valve Needed

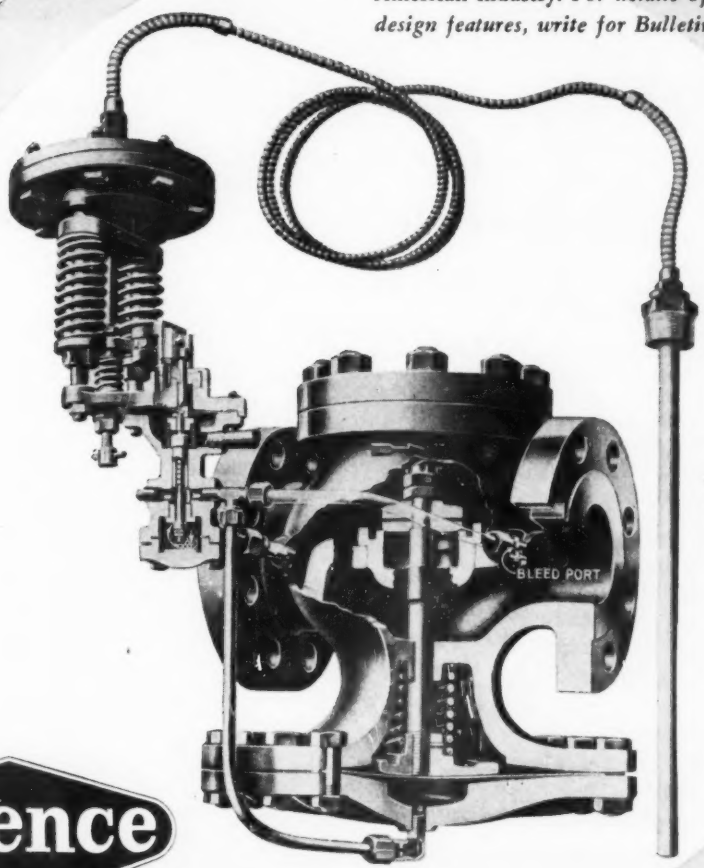
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*



SPENCE
TYPE ET150
Temperature
Regulator

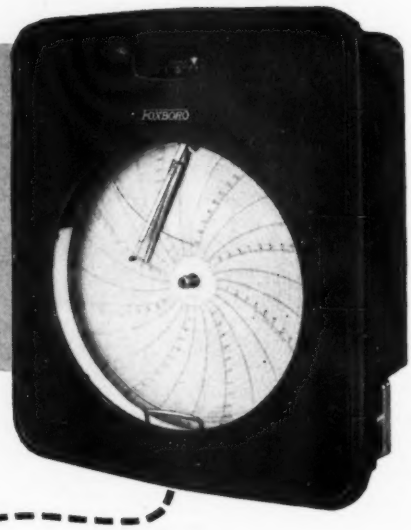
Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

98-139

An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS



You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between −100° and +600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins.

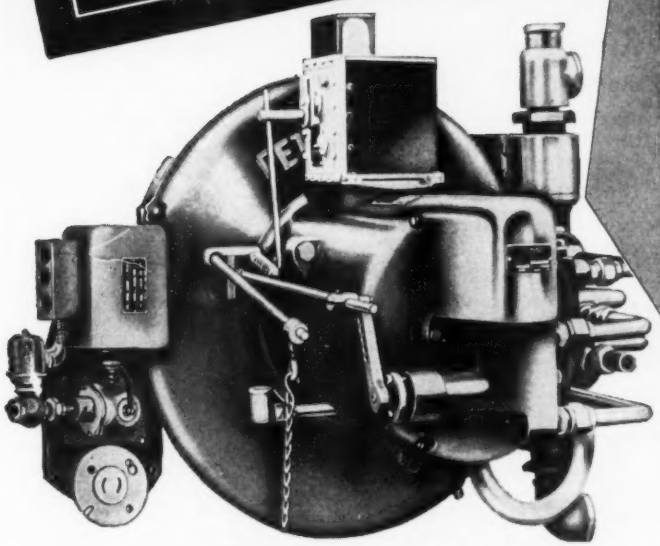
The Foxboro Company,
689 Neponset Ave.,
Foxboro, Mass., U.S.A.

for any range between −100° and +600°F.

FOXBORO REG U S PAT OFF **INSTRUMENTATION**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Are steam costs YOUR responsibility?



MODERNIZE WITH A Petro INDUSTRIAL OIL BURNER

...and cut steam costs!

HERE'S WHAT PETRO WILL DO FOR YOU:

LOW FIRST COST

Petro industrial oil burners are designed and built to *modernize* the firing of your present boilers. This means that you save substantially on initial installation costs—yet enjoy the efficiency, the dependability, and the complete automatic operation that has been traditional with Petro burners for over 50 years.

LOWER FUEL COSTS

A Petro oil burner's economy is unchallenged. You save two ways. First, you save on fuel cost, because heavy oils cost less per gallon and have higher heat value. And second, a Petro burner is designed to burn these low-cost, heat-rich heavy oils with complete dependability. Whether the oil is thick or thin a Petro feeds it steadily under precise automatic control. You get more efficient firing.

UNUSUAL FLEXIBILITY

Here is another Petro value. Under automatic modulating flame control it is extremely flexible in following fluctuating steam demands. If yours is a problem of "high and low" steam requirements—then a Petro burner is your answer. It follows the load without hesitation, and throttles down to a steady low burning rate if desired.

LOWER OPERATING COSTS

Petro industrial oil burners and combustion oil-gas burners are completely automatic. They require a minimum of supervision. Boiler rooms stay clean. The simple, sturdy design of the Petro burner and its easy accessibility reduce upkeep to a minimum—save you money year after year.

Leading heating contractors everywhere recommend and install Petro oil burners. See your contractor, or mail coupon below.

Industrial and Commercial Oil, Gas and Combination Oil-Gas Burners, Residential Oil Burners, Oil and Gas Furnaces and Boilers

PETRO

T.M. Reg. U.S. Pat. Off.

50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT

PETRO, 3207 West 106th Street, Cleveland 11, Ohio
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Please send me the Petro catalog of commercial-industrial oil and gas-oil firing equipment.

see our catalog in ARCHITECTURAL FILE or write for copy

Name _____

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We are known by the customers we *keep*

Year after year, since 1904, we have been serving outstanding industries and institutions from coast to coast and in many foreign countries.

Adaptability to their maintenance problems and dependability have made our organization the leader in this field.

The fact that our customers continue with us year after year proves that they recognize the unusual values of our products and services.

Write today for free technical information on any of these guaranteed PEROLIN PRODUCTS:

- Algae Preventive
- Rapid Cleaner
- Condenser Treatment
- Boiler Treatments
- Soot Remover
- Tank Coating
- Brine Treatment
- Drain Cleaner
- Feed Water Treatment
- Fuel Oil Treatment
- Humidifier Treatment
- Water System Treatment
- Diesel Fuel Oil Treatment
- Steam and Return Line Treatment

The PEROLIN COMPANY, *Inc.*

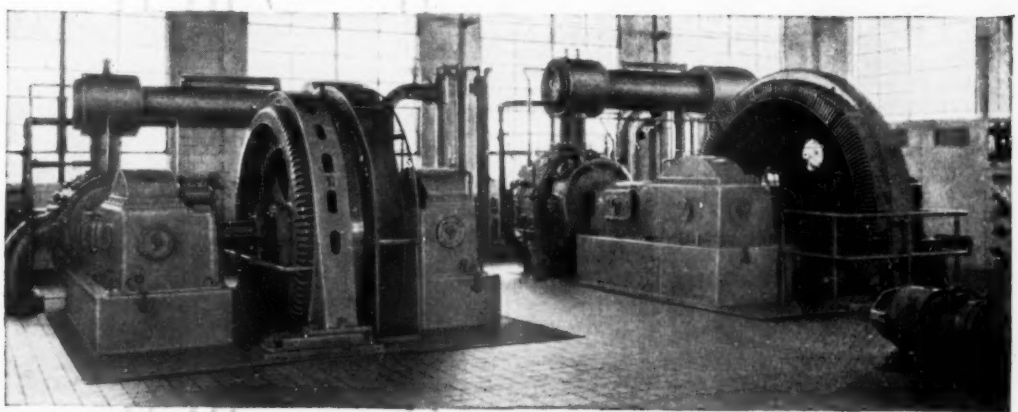
Manufacturing Chemists since 1904

10 E. 40th St. NEW YORK 16 • 1112 W. 37th St. CHICAGO 9

22 WAREHOUSES IN THE U.S. AND CANADA

NO CLOCK PUNCHING

for these compressors



That's right! There's no daily time limit placed on the work output of Chicago Pneumatic Class O-CE Compressors . . . they operate "around the clock" with a minimum of attention. Designed for continuous, year-in, year-out heavy industrial usage, these units are unsurpassed for a dependable air power supply at low cost. Built in sizes up to 2,000 hp, for pressures up to 5,000 lbs., they are available in horizontal, two-stage, water-cooled types with direct-mounted synchronous motor drive.

The Chicago Pneumatic Class O-CE Compressor is equipped with roller bearings, Simplate valves for low power consumption, streamlined air passages to cut down air flow resistance, CP Multi-Step Control for partial load economy, and a CP Intercooler for maximum heat transfer and low water consumption. Ask for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, N.Y. 17, N.Y.*

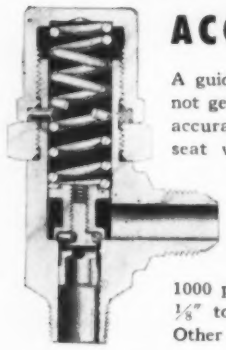
Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

REPUBLIC

VALVES

INDUSTRIAL • CHEMICAL • AIRCRAFT



ACCURATE RELIEF

A guided piston that cannot get out of line assures accurate relief, and long seat wear. High quality springs make settings permanent. Angle type — brass, or aluminum alloy; In-line type — steel, or aluminum alloy. Pressure settings to 1000 psi. Metal-to-metal, or "O" ring seal. ⅛" to 1" pipe, AN, or JIC connections. Other sizes and materials to order.

Write for complete catalog and nearest distributor.

CHECK RELIEF PLUG GLOBE NEEDLE

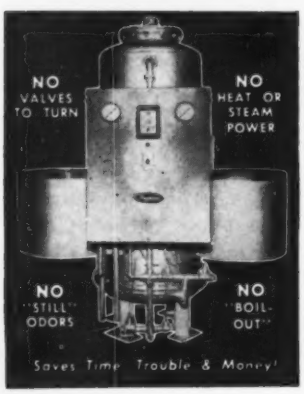
RM REPUBLIC MANUFACTURING CO.

1930 WEST 77TH STREET • CLEVELAND 2, OHIO

HIGH PURITY

WATER

For Boiler Feed, Process & Other Needs



The new Penfield Mono-Column Demineralizer pictured above performs all its operating functions automatically — even accomplishes complete regeneration, including automatically recutting in effluent, with one turn of a switch. Write for full information on units of any desired capacity from 10 to 10,000 gph.

THE LOW COST, NO MUSS, NO FUSS WAY!

Employing the most effective deionizing technique known (intimately mixed cation and anion exchangers in a single tank), raw water passes through a Penfield Automatic Mono-Column Demineralizer only once — *yet comes out with resistances reported as high as 20,000,000 ohms.* Better mineral-free purity than is practical by distillation is supplied for *only pennies per each 1,000 gallons.* And everything is accomplished completely automatically—*without muss or fuss.*

No "Extras"! No "On-The-Job" Assembly Problems!

Penfield Demineralizers are shipped ready-to-operate. Standard equipment includes MONEL METAL regeneration tanks and all necessary gauges, flow meter, conductivity meter, etc. Simply connect the completely "packaged" unit to service lines and start operation.

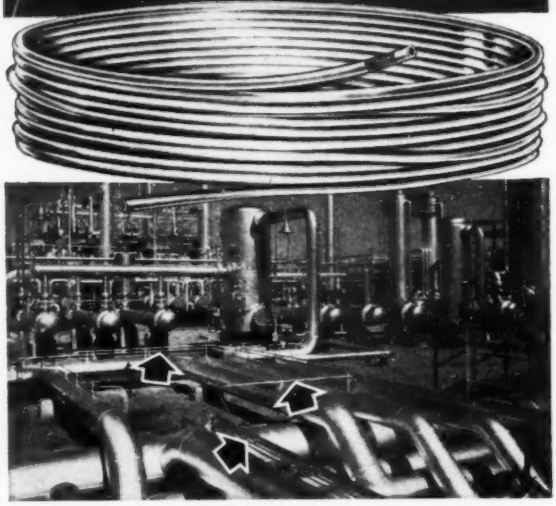
PENFIELD MANUFACTURING CO., INC.

19 High School Ave., Meriden, Conn.

FILTERS • SOFTENERS • DEGASIFIERS • DEMINERALIZERS

Penfield "Planned Purity" PAYS!

Save 40% with ALCOA UTILITUBE



Instrument air lines of ALCOA Aluminum Coiled Tube, still in good condition after five years of outdoor service at Sun Oil Company's Delhi (La.) Gasoline Plant, have required no maintenance since they were installed early in 1948.

ALCOA UTILITUBE* is aluminum coiled tube made of a specially selected alloy to provide low cost, easy workability and high fatigue strength.

Alcoa Utilitube offers savings up to 40 per cent over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

Use Alcoa Utilitube for:

- Air for pneumatic and hydraulic control circuits and brake lines.
- Gasoline and fuel oil for internal combustion engines.
- Lubricating oils for engines and machines.
- Fluids for hydraulic systems.

For complete details, write for the new booklet "Alcoa Utilitube."

ALUMINUM COMPANY OF AMERICA
1004-J Alcoa Building, Pittsburgh 19, Pa.

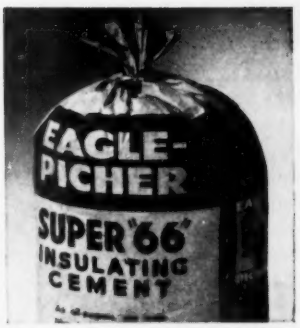
For process chemicals—catalysts, catalyst supports and desiccants—investigate ALCOA *Chemicals.*

*Registered Trademark, Aluminum Company of America

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

EAGLE-PICHER "Super 66" Insulating Cement



Conforms to Commercial Standard CS-117

IT STICKS

to hot or cold surfaces

Because Eagle-Picher Super "66" Insulating Cement *really sticks*, it has money-saving advantages that are apparent the minute your crew begins to apply it.

Because *it sticks*—less time is wasted in application—it stays where you put it whether the equipment is heated or temporarily out of service. It "holds together" — usually no reinforcing needed on applications up to 1½ inches thick.

Because *it sticks*—Super "66" can be used effectively, economically on all types of surfaces—flat, curved, overhead—anywhere you need insulation. It's truly an all-purpose cement.

And—Super "66" is rust-inhibitive—cannot cause corrosion–actually helps prevent corrosion of costly equipment.

If you've never tried Eagle-Picher Super "66," it will pay you to learn more about it today!

"Springy Ball" structure—*the secret of the high thermal efficiency of Super "66." These small, resilient pellets of mineral wool, each one honeycombed with thousands of minute air cells, effectively resist the flow of heat even when used on equipment heated to 1800 F.*

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, you should investigate these Eagle-Picher products: Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic Stamastic • Insulseal • Finishing Cements • Insulating Cements • Swetchek • Insul-Stic • Fireproofing Cement

Member of Industrial Mineral Fibre Institute

NEW JERSEY PROCESS PLANT SAVES NEW FEED PUMP COST

Expansion plans called for a new boiler, and the Chief Engineer thought he'd need a new feed pump too. Pumps on hand — two 10 x 6 x 10's — often needed repairs to meet existing demand. Leaking valves kept them below capacity most of the time. He tried Sims Pump Valves before the new installation was completed and found, even at slower speeds, his pumps still supplied all the water necessary. When the new boiler was put on the line, the same pumps with Sims Valves carried the load easily.

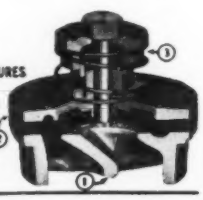
Three years later the Chief said, "Sims Valves were a good investment." They were — but he couldn't lose anyhow. Sims Valves were *guaranteed* to give him better performance — complete satisfaction.

See how Sims valves can help with your pump problems. Carried in stock to fit over 40 different makes of reciprocating pumps — and hundreds of sizes — they'll fit your pumps — improve performance. Free catalog shows how.

SIMS
PUMP VALVE CO. INC
504 PARK AVE. HOBOKEN, N.J.
M & M BLDG., HOUSTON, TEXAS

...Only **SIMS** HAS THESE PATENTED FEATURES

1. Inclined ribs, which help increase pump capacity 20%.
2. Valve disc that rotates every time it lifts
3. Double shock-absorber stem head.



PRE-FABRICATED PIPING -UNVARYING in QUALITY

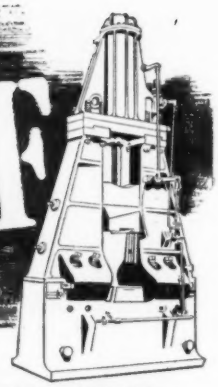
Correcting Heavy Wall Bend To Exact Dimensions

● At Western Piping Supply, the men who weld, align, heat treat and test all have special qualifications for their particular tasks. Most, also, have many years of service with the company.

This combination of skill and experience spells out uniform quality in every job, from job to job, year in, year out. It's a good reason why WPS enjoys an exceptionally high customer repeat rate, and good reason, too, why you should specify WPS when you want superior quality piping.

WESTERN PIPING SUPPLY DIVISION
THE LUMMUS COMPANY
504 WEST 145TH STREET, EAST CHICAGO, INDIANA
Representatives in Major Cities
FABRICATORS OF CARBON AND ALLOY PIPING

The PROOF of the PACKING ...is in the TESTING



Palmetto Pyramid: 17 to 7 — At the Canton Drop Forgings and Mfg. Co., a 5000 lb. Steam Drop Hammer was used to compare Palmetto Pyramid #2500 with a conventional square packing. Results: 24 lbs. of square packing were used in 7 weeks. After the initial packing — rings were added 2 or 3 at a time. This means approximately 3 complete sets of square packings in 7 weeks.

ONE SET OF PYRAMID #2500 (NO RINGS ADDED) LASTED 17 WEEKS!

PALMETTO PYRAMID

A combination of Strength and Adaptability. Made of endlessly folded fabric, it can't split or fray; being molded, it is much denser and more wear resistant than conventional packings; asbestos-reinforced, it can withstand temperatures of 600° F.; patterned on a square, each ring provides a solid base for the one above. This strength, combined with the flexibility of Palmetto Pyramid's design, provides the formula for real heavyweight service.

FOUR WAYS FLEXIBLE

1. Single-line contact — facilitates instant response to pressure changes.
2. Lip curve — provides free entrance for pressure medium, assures positive sealing action and thorough lubrication.
3. Lateral surface — is largely sealing surface. Means fewer rings — less friction — longer life.
4. Automatic sealing — means tighter sealing with increasing pressure. But no binding — for adjustment is self compensating through internal pressure.

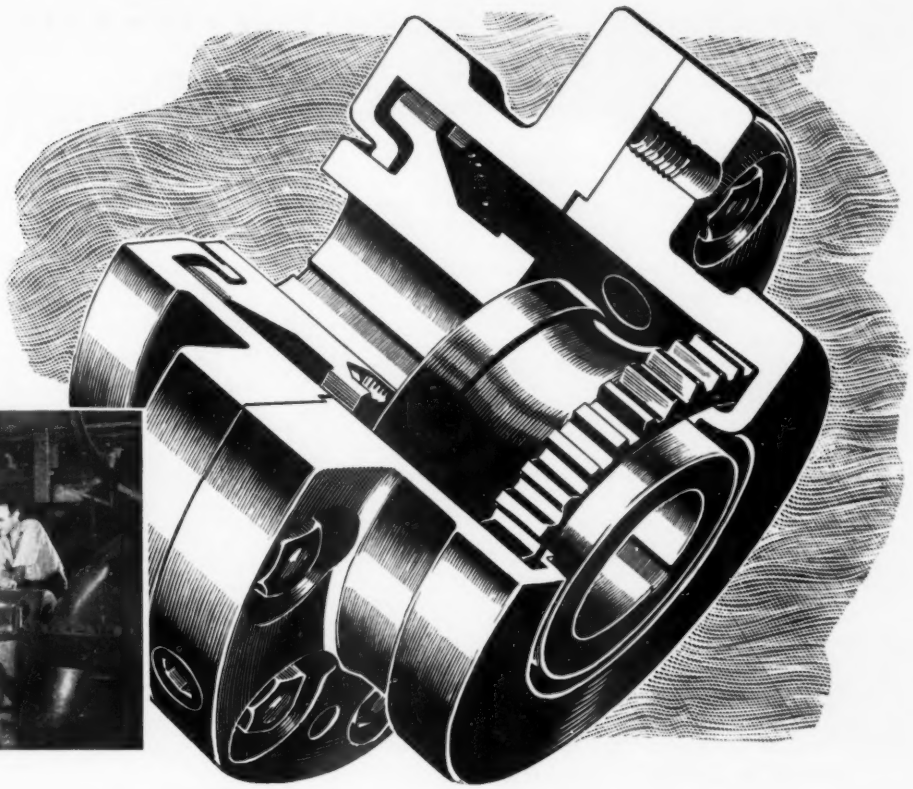
Palmetto Pyramid not only can take it. It can take it longer. Because it *rides with the punches* Send for catalog PC-102 covering complete Palmetto line.

OUR 90th YEAR — NEARLY A CENTURY OF *Quality*

packing more performance into every application

PALMETTO *Packings*

GREENE, TWEED & CO. North Wales, Pa.



ALL COUPLINGS at Southwest Sewerage Treatment Plant, Sanitary District of Chicago, are Fast's . . . like this No. 10 Heavy-Duty Coupling connecting 300 cu. ft./second pump with a 2300 h.p. turbine and gear.

For free engineering service that saves dollars and down-time . . .

FAST'S Couplings are FIRST!

When you specify Fast's Couplings, you get the benefit of Koppers *free engineering service* . . . your assurance of the right coupling for any job and the right solutions to tough coupling problems.

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Add the *rugged construction* of Fast's Couplings . . . with their original design maintained without basic change or sacrifice in size or materials. Add their lowest cost per year . . . their life expectancy guarantee. *Fast's usually outlast the equipment they connect.* Result: it will pay you to write today for full details on how Fast's Couplings and Koppers Engineering Service can help you get uninterrupted power transmission! Send for free catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 229 Scott Street, Baltimore 3, Md.

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FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered* Products Sold with *Service

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Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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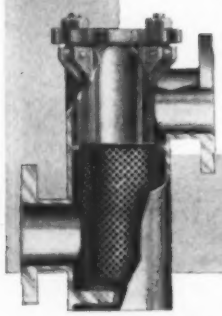
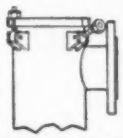


S-Type ADSCO Strainers screen out foreign matter from oil, water, and other liquid lines. Damage to valuable equipment is prevented. Usually installed on suction side but can also be used for discharge or other services.

S-TYPE

STYLE B COVER

Toggle and Bolt Type



Cover held in place by toggle bolts. This design simplifies removal of cover while cleaning basket screen. In sizes from 4" to 12", for pressures to 50 psi.

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NORTH TONAWANDA, NEW YORK
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for a company with a Water Problem...

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A Ranney Water Collector will add millions of gallons to your daily water supply—at a fraction of the cost of conventional systems!

2. Less Expensive to Operate!
A Ranney Water Collector is far less expensive to operate—uses fewer pumps, fewer personnel, less power, and usually requires no treatment facilities.

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A Ranney Water Collector requires little or no maintenance. The rate of flow through the Ranney Collector's apertures eliminates clogging and silting. No filter plant maintenance.

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A single Ranney Water Collector has produced more clear, cool water than ten conventional vertical wells.

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Ranney Water Collectors are currently rendering excellent service to scores of large water users such as:

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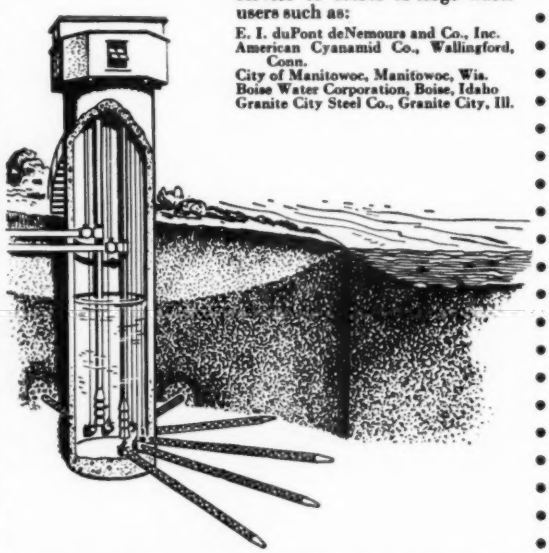

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Investigate these compact, simple units and their many other advantages for heating your fuel oil. Complete information will be sent without obligation.

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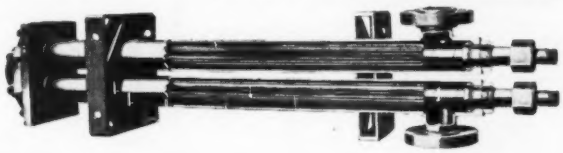

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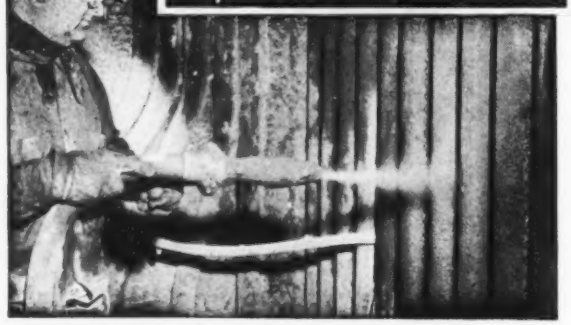
"GUNITING" with Super ADACHROME-CAST



Tradename "Guniting" courtesy Cement Gun Co., Allentown, Pa.

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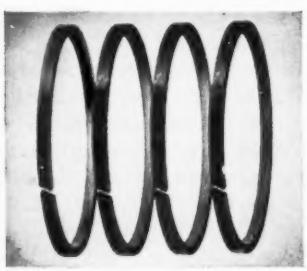
Originally developed under Sea-Ro exclusive patents. Once installed it forms a fine bearing surface, gives steady, reliable trouble-free service.

#525 SPRING RINGS

Expansion ring "floating" type, especially adapted for large, heavy-duty pumps. Long wearing with minimum friction.



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Rings and packing, precision made to specification for pumps on **ALL TYPES OF VESSELS**

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for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
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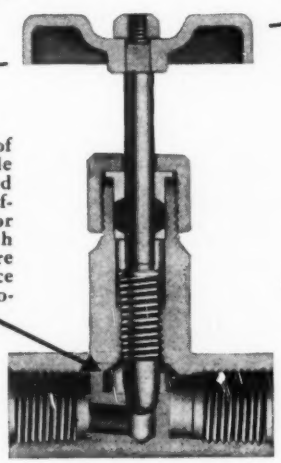
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.



ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.

Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

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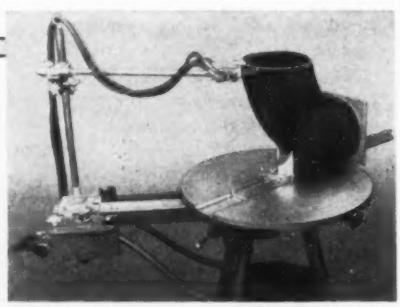

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Use this new precision "Universal" Flame Cutter for re-working, reconditioning and salvaging all types of new and used welding ells, tees, flanges, reducers, etc. Makes extremely clean cuts... no cleaning or hand fitting required. Adjustable degree plate permits fitting to be cut at any angle. Has unitized control panel and unitized gas control valve.

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- Re-cuts and bevels used ells, tees, swedges, returns.
- Reconditions welding neck and slip-on flanges.
- Reams extra heavy fittings to standard.
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- Cuts holes in blanks for slip-on reducing flanges.
- Cuts and bevels short pieces of pipe to 36" diameter.
- Makes swedges out of welding caps.
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THE NEW VERNON "Universal" FLAME CUTTER

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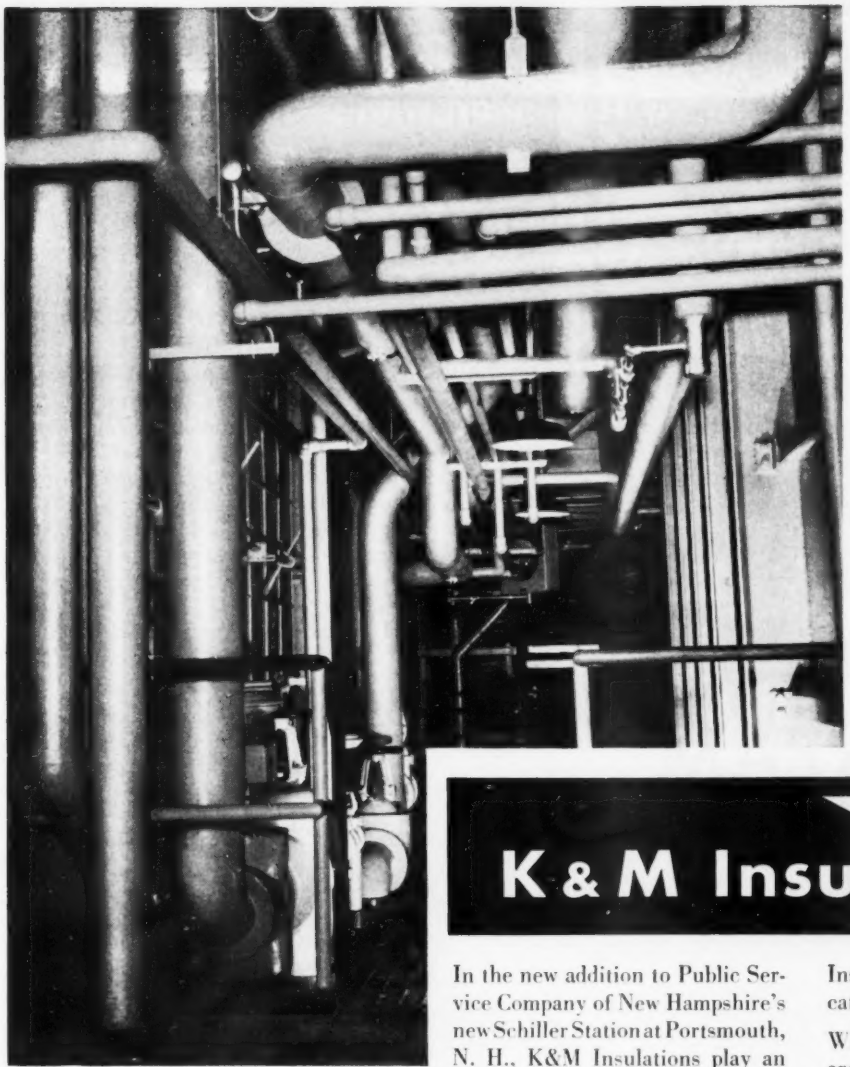

Schiller Station, Public Service Company of New Hampshire, at Portsmouth. Insulation Contractor: Armstrong Cork Company.

Keep heat loss at a minimum with dependable

K&M Insulations

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These heat-saving money-saving insulations are supplied in sections, blocks, and segments to suit them to any application. Your K&M distributor is an experienced applicator who will gladly tell you more about them. Or write direct for detailed information.

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10 to 600 h.p...
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AMESTEAM GENERATOR

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★ all piping and wiring, ready for your service connections.

★ fan, feed water pump, condensate tank, injector, blow-off valve, necessary refractories, insulation and metal jacket.

ALL YOU NEED is fuel tank, gas vent and service connections.

—AND YOU KEEP RIGHT ON SAVING

with these trouble-free, fully automatic units with their eye-level controls, their accessibility inside and out, and fuel-saving 80% guaranteed efficiency!

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BRITONS CAN HAVE PROSPERITY —If They Want It

What is required to get Britain, our key ally in the grand alliance of the free world, firmly back on her economic feet? The purpose of this message is to throw light on this crucial problem, which afflicts our other European allies also.

At the moment, Britain is enjoying a respite from the economic crises (of 1947, 1949 and 1951-52) which have plagued her postwar course. This respite may well continue for some time. But almost no one whose judgment is trustworthy believes that Britain has acquired sufficient economic strength to safeguard her against further economic crises in the years immediately ahead.

Two British Views

New and clear light on what should be done to that end has recently been shed by two noteworthy British publications. One is a book, "We Too Can Prosper," by Graham Hutton, distinguished British economic writer and administrator. The other is an article, "The Riddle of Prosperity," published by THE (London) ECONOMIST, Europe's most eminent economic journal.

Combined, these two publications present in sharp relief the basic problem that must be handled successfully if Britain is to be safely solvent. As is implied by its title, ***the Hutton book demonstrates that Britain can be made prosperous by readily feasible procedures, patterned on what has been done in the United States, to increase its industrial efficiency. But, says THE ECONOMIST, with Mr. Hutton's book in mind, this is not the most basic problem, which is, "How shall we make the British people determined to be prosperous?"*** This is a problem of incentive or motivation.

Compared with that of the United States, average industrial efficiency in Britain, as in most of Western Europe, is low. In his book Mr. Hutton remarks that "fifty years ago an American industrial worker turned out roughly the same amount in a day as his opposite number in Britain, Germany or France. . . . Today, he turns out from two to five times as much."

In large part it is this lag in output per hour or "productivity," as the technicians call it, which makes Britain and other key countries in Western Europe a continuing prey to economic crises. Moreover, the great disparity in productivity between the U.S.A. and most

of Western Europe is a major barrier to knitting the free world into a smoothly working economic whole. As one observer put it, "when the American economy catches a cold, the European economy gets pneumonia." This is largely because Europe is so much weaker in productive strength.

No Shortage of Knowledge

Yet the knowledge which would enable the countries of Western Europe, and particularly Britain, to increase their industrial productivity has been mobilized and is readily available to them. It is with this process for Britain that Mr. Hutton's book is concerned. In the book he summarizes the findings and conclusions, virtually all of them unanimous, of 66 teams, composed of British industrial managers, technicians, shop workers and labor leaders. Over a period of three years these teams completed a comprehensive series of inspection and study trips in the United States under the sponsorship of the Anglo-American Council on Productivity. The product of that effort, he remarks, is "a set of documents the like of which, on such a scale and of such practical value, has never been seen in the history of international and cultural borrowing."

Psychology the Key

From study of these documents, Mr. Hutton concludes that better capital equipment is the key technical ingredient of higher industrial productivity in Britain, and constitutes "the most urgent . . . need of British industry." But he finds that ***even without new capital equipment a "15% rise in productivity can still be achieved by reorganization of work," and that such an increase would "solve Britain's chief social and economic problems."***

Then why is not such an increase in productivity, demonstrated by the Anglo-American productivity teams to be so clearly within technical grasp, promptly forthcoming? Mr. Hutton, quoting one of the team reports, remarks that, ***"'the greatest obstacles to increased productivity are psychological rather than technical.'*** We have to deal first and foremost with men, not machines." And THE ECONOMIST, pursuing the line of inquiry suggested, reaches the conclusion that, by and large, the people of Britain do not want to prosper by being more efficient. THE ECONOMIST says:

> "The real secret of American productivity is that American society is imbued through and through with the desirability, the rightness, the morality of production. . . . But in Britain, if any moral feeling at all survives about economic matters, it is usually a vague suspicion that economic success is reprehensible and unworthy. From this difference in attitudes everything else follows."

"How," asks THE ECONOMIST, "shall we set about restoring some belief in the rightness of effort, the morality of success?" For this question it has no ready answer. Neither have we. We are confident that the British people will neither be cajoled nor coerced into trying to match our productivity. Basically the problem seems to be to demonstrate clearly to them the truth of the proposition, set down by Graham Hutton, that "there is no goal, aim or end before a Good Society which the raising of that society's material productivity cannot render easier of achievement." Doing that in an old and settled country like Britain is obviously an extremely formidable undertaking. But ***until it is done, the crucial job of getting Britain and the rest of Western Europe firmly on its economic feet will remain to torment all of us.***

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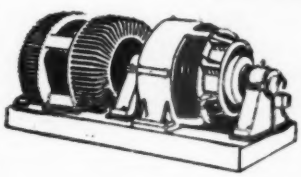

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750	*G. E.	KT	720
700	G. E.	FT	3600
500	*A. C.	6316SW	1800
400	*G. E	KF559	3600
300	*West.	CS	3600
250	*L. Allis	OGX14S	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	A. C.	ARWX	3600
200	*G. E.	IK13B	1800
200	A. C.	ARWWT	600
200	G. E.	IK17	600
200	*West.	CS	600
200	*G. E.	K6325S	514
150	A. C.	AR DP	3600
150	*A. C.	AN	1800
150	G. E.	IK13A	1800
150	G. E.	IE-K	1200
150	G. E.	KT558	900
150	*G. E	KT566 TEFC	720
150	G. E.	IK16	600
150	*West.	CS 3-brg.	600
125	West	CS504S	3600
125	*A. C.	AR226	1800
125	*Reliance	AA6085 BB	900
125	A. C.	AR	900
100	L. Allis	EX114SExPr	3600
100	*G. E.	FT542Z	1800
100	G. E	FTRP543	1800
100	*West.	CS	1800
100	A. C	AW	1200
100	G. E	IK13A	1200
100	U. S.	CFU (vert)	1200
100	*West.	CS (vert)	1200
100	*West.	CS774C	900
75	West.	CS445S	3600
75	G. E.	KT537	1800
75	G. E.	IK11A	1800
75	A. C.	AR505	1200
75	Howell	TEFC	1200
75	G. E.	KF542 BB	1200
75	*A. C.	AR (vert)	900
75	A. C.		900
75	A. C.	AN	720
75	G. E.	IK	600
75	Fair-Mor	H24B BB	514
60	G. E.	KF444Z	3600
60	*West.	CS504S	1800
60	A. C.	APZ445S TEFC	1800
60	*West.	CS505S TEFC	1800
60	*G. E.	KT537	1800
60	A. C.	APZ504U TEFC	1200
60	West.	CS752C	1200
60	West.	GS857C TEFC	1200
60	A. C.	AR504U	1200
60	*G. E.	KT343	1200
60	G. E.	KT343	1200
60	Cr.-Wh	SC505	1200
60	A. C.	AR823	900
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50	G. E.	K404	3600
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1500	*G. E.	MT-30	240
1250	*West.	CW	600
1000	*West.	CW	250
700	*A. C.	ANY	720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	*G. E.	MT	450
500	West.	CW	350
400	A. C.	3-brg.	450
400	*G. E.	MT412	450
350	West.	CW	900
300	*G. E.	IM13A	1800
300	*G. E.	MT410	450
250	West.	HF15H	600
200	G. E.	IM15	1200
150	G. E.	MT549 BB	1800
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM13A	1800
100	G. E.	IM15A	450
75	Northw'n	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	West	CW762C	900
50	G. E.	IM11A	1800
50	*A. C.	ARY	1800
50	West.	CW636A	1200
50	G. E.	MT346	720
50	G. E.	IM14	450
40	*G. E.	MT532	1200
40	G. E.	MT336	1200
35	Fair-Mor.	UAB (vert)	1800
35	G. E.	IM	1200
30	G. E.	MT532	900
30	G. E.	MT326	1200
25	G. E.	MT522	1200
25	G. E	MT526	900
25	G. E.	MT536	720
20	G. E	MT322	1200
20	G. E	IM	900
20	G. E.	MT322	900
20	G. E	IM11A	720
20	G. E.	IM12	600
15	L. Allis	OH326	1800
15	A. C.	ARY326	1800

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850	West.	3	34160	455
667	G. E.	1	3000	480
500	American	1	2400	240/480
400	West. (air)	3	12000	213
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
250	G. E.	1	4160	240/480
200	Wagner	1	2400	575
167	A. C.	1	2400	120/240
100	Pittsburgh	1	2400	575
100	Pittsburgh	1	2400	240/480
100	American	1	2400	240/480
100	G. E. (Fy'l)	1	2400	120/240
50	West.	1	2400	120/240

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800	*G. E.		1.0	1800
710	*G. E.	ATI	1.0	720
700	*G. E.	TS975Z	1.0	1200
600	*G. E.	TS7640	1.0	900
600	*G. E.	TS	1.0	600
600	*G. E.	ATI	1.0	240
400	West.	HG	1.0	900
300	G. E.	ATI	.8	1200
300	G. E.	ATI	.8	900
300	*G. E.	ATI	1.0	720
300	Ideal	SNS	1.0	257
250	*Cr. Wh.	25184	1.0	1800
220	*West.		1.0	600
190	El. Mhy.	2S	1.0	720
175	*West.	HR	1.0	360
150	*West.	HR	1.0	300
125	*G. E.	ATI	1.0	900
125	*El. Mhy.		1.0	900
125	*G. E.	TS	1.0	277
115	El. Mhy.	EM	1.0	240
100	*G. E.	ATB	.8	900
100	*West.		1.0	900
100	Ideal	SNS	1.0	900
100	G. E.	TS6184	1.0	450
20	Fynn-W	15VRN		1200
15	Ideal			1800
15	Century	ARC365	1.0	1200
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312	G. E.	ATI	900
300	*G. E.	ATI	720
225	G. E.	ATB	600
187	West.	ES	720
100	*G. E.	ATB	900
60	Fair.-Mor.	B	900
55	G. E.	ATB	1200
50	G. E.	ATB	1200
50	West.		1200
50	G. E.	ATB	900

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KW	Make	AC	DC
2400	West. (3-u.)	4800	525
1000	West. (3-u.)	11000	137/275
500	AC-West.	2300	250
450	G. E. (3-u.)	2300	125/250
400	A. C.	2300	120/240
300	Cr. Wh.	440	250
200	G. E.	440	550
200	West.	2300	275
200	G. E.	440	600
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
125	G. E.	440	300
125	West.	440	250
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	Ridgway	2200	275
100	West.	220	125
100	Elec. Machy.	220	125
90	G. E.	220	250
90	G. E.	440	60
75	Reliance	2300/440	250
75	G. E.	440	125
60	A. C	2300	110
50	G. E	440	250
40	A. C.	220	125
35	West.	2200	125
30	G. E.	220/440	250
25	Cr.-Wh.	440	125
20	G. E.	440	250
20	Bogue-GE	550	250
20	Bogue-GE	220/440	125

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HP	Make	Volts	Speed
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

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250	G. E. (550 v)	MPC4	700
200	Cr.-Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	RC34	2500
100	G. E.	RC19	575
100	West.	MC90	460
50	G. E.	RC35	700
50	G. E.	DLC-204	650
35	Cr.-Wh.	CM351	700
30	Cr.-Wh.	CCM	440
30	Sprague	C-60	240/300
25	West.	SK100L	1100
25	G. E.	RC32	900
25	G. E.	RC32	800
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KVA	Mfr.	Type	Volts	Speed
1000	Whse syn cond		4000/2300	900
625	Gen Elec	ATB	2300	450
625	G E 25 cycle	ATB	2300	750
600	Gen Elec	ATB	480	900
625	El Machy	Late	240/480	1200
485	Allis Ch	1 brg	480	400
350	El Machy	1 phase	480	1200
312	Gen Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200

SPECIAL PURCHASE

2—DC 55 V. 3600 Amp. M-G Sets

Input—300 H.P. Whse. synch. motor, 3/60/220/440 V. 720 RPM, w/exciter.

Output—200 KW. generator, DC 55 V. 3636 amp. 720 RPM, w/exciter.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Alls. Ch. b.b.	EW	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
100	Whse.	SK	250	1200
75	Cont. b.b.	D109X	125	1200
75	Gen. Elec. (2)	CD115	250	1500
75	Whse.	SK	250	1200
60	Whse.	SK160	250	1000
50	Whse.	SK	250	1100
50	Allis. Ch.	EW	125/250	1200
50	Gen. Elec.	RC	125	1200
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	250	500
300	Allis. Ch. b b	EW	350	1000
200	Al Ch. b.b.	E	250	500/1000
100	Gen. Elec.	CD115	230	1750
100	Whse.	SK	230	850
75	Whse.	SK170	230	635
75	G. E (2)	CD 115	230	1150
75	Whse.	SK163	230	850
60/75	Gen. Elec.	C	230	500/1200
50	Whse.	SK150	230	750
50	Reliance b.b.	65IT	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Gen. Elec.	RC33	115	100
50	Cr.Wh.b.b.(3)	FH	230	1750
40	Gen. Elec.	RC32	550	1200
40	Gen. Elec (2)	CD-93	115	1750
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Gen. Elec.	LC	230	500/1500
30	Whse.	SK110L	230	1150
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD85	230	1750
25	Gen. Elec.	CD105	230	575/1720
20	Century b.b.	DN330	230	3505
20	G. E. series	CO-1826	230	875
20	Whse. b.b (2)	SK97	550	900

A. C. MOTORS

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E	Synch	2200	514
600	E M	Synch.	480	1200
600	G. E. (2)	Synch.	2200/440	360
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
450	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200	1200
350	G. E.	Slipring	2200/440	300
350	Whse. (2)	Slipring	2300	450
300	Gen. Elec.	Slipring	2200/440	720
300	Al. Ch.	Sq. Cage	2200/440	720
300	El. Mach.	Synch.	2200	360
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E.	Slipring	2300	450
250	G. E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Allis. Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	G. E.	Sq. Cage	220/440	600
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slip Ring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Sq. Cage	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	Rel. b.b.	Sq. Cage	220/440	1200
200	E. M.	Synch.	220/440	514
175	Whse.	Synch.	220/440	360
160	Whse.	Synch.	220/440	600
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis. Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	Allis. Ch. b.b.	Sq. Cage	2200	900
125	G. E.	Slipring	2200/440	720

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	Whse.*	2300 AC	250 DC
200	Allis. Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis. Ch.	2200/440 AC	350 DC
250	Cr. Wh.*	2200/4000 AC	250 DC
200	Whse.*	2200/4000 AC	250 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G. E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
105	Century b.b.	220/440 AC	70 DC
100	Al. Ch.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
90	G. E.* (2)	220/440 AC	125 DC
80	Star* b.b.	220/440 AC	240 DC
75	Cont. b.b.	220/440 AC	125 DC
75	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Allis. Ch.	220/440 AC	125/250 DC
45	Gen. Elec.*	220/440 AC	60 DC
40	Gen. Elec.	220/440 AC	600 DC
30	Otis (5)	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
20	Star b.b.	220/440 AC	120 DC

*Synch. motor.

THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK

FREE!

New WAGNER MOTOR-GRAM lists hundreds of bargains in new and rebuilt Electric Motors and Generators. Write today!

OUR 47th YEAR

Serving American Industry

ARTHUR WAGNER COMPANY

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TELEPHONE MOnroe 6-7409

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-607S	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBBused
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	K-594S	1800	TEFCBBXP
60	G.E.	OG-44	1800	TEFCBBXP
60	L.A.	QS-444	1800	B. B. open
60	F.M.	FB-404	3600	B. B. open
50	Master	K-445	1800	TEFCBBXP
50	G.E.	K-405	1800	TEFCBB
50	G.E.	CS-445	1200	S. B. drip
50	West.	K-505	900	S. B. open
50	G.E.	AR-444	3600	TEFCBBXP
40	A.C.	KF-365S	3600	TEFCBBXP
40	G.E.	CS-405	1800	B. B. Splash
40	West.	K-405	1800	TEFCBB
40	L.A.	404	1800	TEFCBBXP
40	G.E.	CS-504S	1800	B. B. open

REBUILT SQUIRREL CAGE MOTORS

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S.B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM. We also carry in stock a large quantity of used electric motors from 1 hp up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER

EQUIPMENT COMPANY

8 CAIRN ST., ROCHESTER 2, N. Y.

P. O. BOX 534 — Tel: Genesee 5629

1000 KW.

WESTINGHOUSE CONDENSING TURBINE-GENERATOR

MODERN • VERY GOOD CONDITION • A COMPLETE UNIT 400 lbs.

Above Westinghouse is a 1000-KW @ 80%—P.F., 1250-KVA., 400# psig., 3/60/2300-v. Is Complete with all piping and accessories, Surface Condenser, Switchboard, Shaft Exciter, Etc. Turbine Serial #12580: Generator #4791874. IMMEDIATE DELIVERY.

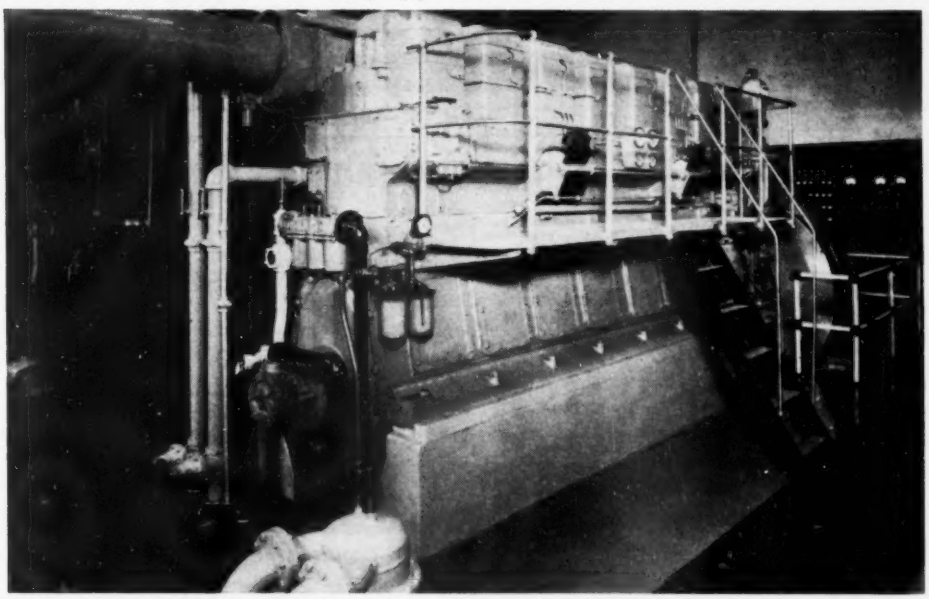
WE CAN DELIVER FROM STOCK ALMOST ANY TURBINE SET FROM 300 to 5000-KW. Condensing or Non-Condensing. ALSO BOILERS & DIESEL ENGINES.

Send Us Your Specifications

2250-KVA., G.E. DESTROYER ESCORT TURBINE-GENERATOR, 440# psig., 750° F.TT.

3350 HP

COMPLETE COOPER-BESSEMER POWER PLANT: 5-670 HP., Engines 400-RPM., 2300-volt. Each Equipped with 475-KW. IDEAL GENERATORS.



Above 5-670-HP., Engines (our own property) Still on Foundations, Will be run for Inspection. Will sell as Complete Unit, or Engines separately. Each engine equipped with switchboard and all appliances for separate operation. Is the most complete and finest plant we have ever owned. Is priced at a fraction of its original cost. Large lot of spare parts. INVESTIGATE NOW. ENGINES ARE LIKE NEW MACHINES.

ALSO OWN AND OFFER 2—Fairbanks-Morse, 1600-HP., O.P., Diesel Engines, 720-RPM., or 1800-HP., at 800-RPM. Same as New. Immed. Delvy.

DRAWINGS AND COMPLETE DATA ON REQUEST

New England Representatives
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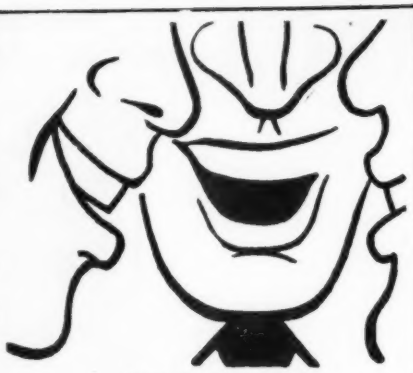
Something to TALK ABOUT

THE MONEY YOU SAVE ON EQUIPMENT GUARANTEED BY HEMPHILL ELECTRICAL ENGINEERS



This seal says so!

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1500	G.E.	Pyranol	3	4150x2400
1	1000	G.E.	Auto	3	4150x2400
2	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G.E.	H	1	13200x220 440
2	300	G.E.	H	1	13200x440
4	200	G.E.	H	1	13200x440
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G.E.	H	1	4800x120/240
3	50	A.C.	H	1	230x120/240
1	25	G.E.	H	1	460x120/240
1	20	G.E.	Novalux		2400 6.6 Amps
2	25	G.E.	H	1	575x115/230
	25	Nlag.	OISC	1	2400x480
8	7½	Electran Air		1	460-8-40

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4150SR
1	300	G.E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	181G	330

Qu.	H.P.	Make	Speed	Volts
1	150	A.C.	360	440
1	125	El. Mach.	900	4800
1	100	G.E.	900	2200

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
2	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
1	60	G.E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MFC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	860	RC
1	25	Whse.	825	BK

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"FOR POWER"
J.L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

BOILER FEED PUMPS

We have just acquired these two boiler feed pumps which were installed new in 1950. They are in absolutely top condition.

1—DeLaval Boiler feed pump, rated 600 GPM at 1220 ft. head. Stainless steel fitted 3 stage single suction type 250 M-3P5/4, mounted on base and originally driven by 3600 RPM motor.

1—DeLaval Boiler feed pump, identical to the one listed above except mounted on base with 233 BHP steam turbine, 400 PSIG Steam pressure, 262°F superheat, 50 PSIG discharge.

TURBO-GENERATORS

CONDENSING

1—6250 KVA 5000 KW 3600 RPM Allis Chalmers 200 lbs. 100° SH. Will operate 275 lbs. 6150 TT without change. Generator 3/60/11500. Can be changed to 2400/4160. Complete auxiliaries. Can be operated for inspection. Checked by factory engineer in Sept. 1951—no repairs required.

1—1567 KVA 1250 kw 3600 RPM Allis-Chalmers 150 lbs. Will operate 200 lbs. 450° TT without change. Generator 3, 60/2300. Complete auxiliaries.

1—1250 KVA 1000 kw 3600 RPM Westinghouse 185 lbs. 100° SH 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1—937 KVA 750 kw 3600 RPM Gen. Elec. 150 lbs. Generator 3/60/2300.

NON-CONDENSING

1—1250 KVA 1000 KW 3600 rpm General Electric 140 lbs. turbine with type ATB Form T 3/60/2300, 80 pf, Synchronous Generator.

1—1870 KVA 1500 KW rpm General Elecertic 140 lbs. turbine with type ATB 3/60/2300, 80 p.f., Synchronous Generator.

1—625 KVA 500 kw 3600 rpm General Electric 175 lbs. Single stage turbine with type ATB form T 3/60/2300, 8 pt. Synchronous Generator.

1—187½ KVA 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100° SH. Generator 3/60/240.

1—125 KVA 100 kw Westinghouse geared 7200/900 rpm 150 lbs. 3/60/240.

We will rewind these generators to your specifications

TRANSFORMERS

3 PHASE—60 CY.

1—2500 KVA 11500 to 480 Volt 3 Ph. 60 Cy. General Elec.
1—1800 KVA 6600 to 440 Volt 3 Ph. 60 Cy. General Elec.

1 PHASE—60 CY.

3—3333 KVA 66000 to 33000 & 132000 V 1 Ph. 60 Cy. Westinghouse

2—1000 KVA 13200-2300 v. 1 ph. 60 cy. Gen. Elec.
4—200 KVA 33000-2300/4600 v. 1 ph. 60 cy. Pittsburg
10—100 KVA 33000-2300/4600 v. 1 ph. 60 cy. Pittsburg
3—100 KVA 33000-2300/4600 v. 1 ph. 60 cy. Allis-Ch.
Large stock 2400/4160 Y.—120/240 v. 1 ph. 60 cy. Distribution Transformers
10—25 KVA 65—5 KVA
13—15 KVA 20—3 KVA
63—10 KVA 13—1½ KVA
61—7½ KVA

OUTDOOR INSTRUMENT TRANSFORMERS

2—110000/66000 to 110 volt Westinghouse Potential
13—33000/110 V. 200 V.—A GE E116 Potential
3—33000/110 V. Westinghouse Potential
2—60-120/5A 37 KV GE—K61 Current

OIL CIRCUIT BREAKERS—Outdoor

1—600 A. 110 KV GE FK0136
1—400 A. 73 KV West. G—1
2—400 A. 37 KV GE FK0136
1—400 A. 37 KV WEST. 0221
1—1200 A. 15 KV GE FHK0236

TAMPA ARMATURE WORKS INC.

401 S. MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

LAND'S 44th YEAR
MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE

GENERATORS—250 V. D. C. Motor Driven

KW	Make	Type	Speed
2000	G.E.	New	900
1150	G.E.	New	900
250	Cr. Wh.	CCD	1200
200	El. Machy.	8K	900
150	West.	Synch.	900
125	El. Dy.	MPC	1200
125	El. Dy.	20L	1750
100	Delco (4)		1150
100	G.E.	MPC	1200
75	West.	8K	900
75	Cr. Wh.	51H	1150
60	North West	HH	1150
50	Cr. Wh.		1150
40	West.	8K	1750
35	Al. Ch. (4)	3 wire	1750
25	G.E	CS	1200
17	G.E.	BC	1750
15	Star		1750
7½	West.	8K-43	1750
5	West.	8K-284	1750
5	Rel.	T-23T	1750
3	Rel.	T-14T	1740

GENERATORS—Low Voltage D. C.

Amp.	Make	Voltage
3000/1500	Chandey.	12/22
2500/1250	Chandey.	6/14
2000/1000	H-V-W	6/12
750	H-V-W	6/12
4000/2000	North	7½/12
3000/1500	Chandey	8/15
1000	G.E.	10
6000/3000	El. Prod.	18/35
1000	G.E.	26
1000	West.	25
100	Diehl	34
200	West.	32
200	Burke	35
125	Diehl	45
500	G.E.	30
1500	Century	42
3200	G.E.	55
325	West.	50
1000	G.E.	70

230 V. D. C. MOTORS

H.P.	Make	Type	Speed
350	G.E. (2)	MDP 422	375/750
250	G.E.	MDP 420	410/820
250/200	Rel.	2600T	400/800
150	West.	8K	1150
150	West.	8k	850
150	G.E.	C	325/975
125	Rel.	T	600
125/50	E. D.	20-8L	1750/1315
100	West. (4)	8K	1150
100	Reliance (3)	1050T	400/1200
100	West. (6)	8k	850
100	Rel.	651-T	850
100	G.E.	BC	600
100	Rel.	1060T	500
100	A-C		1150
100	FM	TRC-38	725
90/45	G.E. (2)	RF-17	950/1750
75	G.E.	CD-155	1150
75	West. (6)	8K	1150
75	G.E.	BC	1000
75	Rel.	461-T	850
75	West. (2)	8K	850
75	West.	8K	475
75	Cr. Wh.	CMC-125H	375/950
60	West.	8K	850
60	West.	8K-160	680
60	West.	8K	250/1000
50	Cr. Wh.	CMC-FH	1750
50	West.	8K-160	565
50	G.E.	RF-17	250/10
40	G.E. (3)	CD-105	850
40	Cr. Wh.	FH	1750
40	West. (5)	8K	775
35	E-D	2S8	350/1050
35	West.	8K	250/1050
35	West.	8K	1150

SLIPRING MOTORS

H.P.	Make	Type	Speed
600	Cr. Wh.	131-AQ	507
500	G.E.	IM	600
500	G.E. (2)	IM	450
450	G.E. (2)	1EM17B	880
350	West.	CW	435
250	G.E.	IM	600
200	G.E.	MT-557Y	1750
150	G.E.	IM	870
125	West.	CW	1750
125	G.E.	IM	580
100	G.E.	MT347	1150
100	G.E.	IM	690

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
250	GE(TENV)	K-6335	1750
200	Wagner	RP2-26Z	1800
200	West.		1750
200	A. Ch.	AR	865
200	G.E.	KF-6335	880
150	West.	CS	1175
150	G E.	IK	580
125	Cr. Wh.	53R	3500
125	A. Ch.	AB	1750
125	Century		3500
125	A. Ch.		690
100	West.	CS607S	3540
100	West.	CS	870

Partial Listing Only!

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Established 1910

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RE-MAN BILT

THE TRADE MARK WITH A MEANING
SUCCESSFUL OPERATION GUARANTEED
*45th Year of Service—Member of A.R.A.**

A. C. MOTORS

3 Ph. 60 Cycle

SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1	4350	Cr. Wh.		4160/13800	514
2	3500	G.E.	TS	2300	257
1	2500	G.E.	ATI	2300	720
2	2100	G.E.	ATI	2300	360
2	2000	Whse.		2300	120
1	2000	G.E.	ATI	2300	900
2	1750	G.E.	ATI	2300	3600
3	735	G.E.	ATI	2200/12000	600
1	500	Ideal	SM	2300/4150	1800
1	450	Whse.	Eng.	2200	128.5
1	450	Whse.		2300	450
2	350	G.E.	TS	2200	150
1	300	Whse.		2300	720
1	150	Whse.		440	600

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1500	ABB		2300	720
1	1200	G.E.	MF-26	2300	275
2	1000	A.C.	Mill	2300	240
1	500	Whse.	CW	550	360
1	500	G.E.	IM	2300	900
1	450	G.E.	IM	440	720
1	400	Whse.	CW-1218	2200	435
1	400	Whse.	CW	440	514
1	350	G.E.	MT-442Y	2300/4000	253
1	350	G.E.	IM-17A	440/2300	720
2	300	G.E.	MT-565Y	2300	900
1	250	G.E.	IM-1713	2300	450
1	250	G.E.	MT-424Y	4000	250
1	250	G.E.	MT-539S	2200	1750
1	250	A. C.		550	600
1	200	Cr. Wh.	26QB	440	595
1	200	G.E.	IM	440	435
1	200	G.E.	MTP	440	1170
1	150 new	Whse.	CW	2300	450
1	150	G.E.	IM-16	440	600
2	125	A. C.		440	865
1	125	A. C.		440	720
4	125	G.E.	MT-566Y	440/2200	435
2	100	G.E.	IM	440	600
1	100	G.E.	IM	2200	435
4	100	A. C.		440	695
4	100	G.E.	MT	440/2200	435

SQUIRREL CAGE

Qu.	HP	Make	Type	Volts	Speed
2	650	G.E.	FT559BY	440	3750
2	450	Whse.	CS	2300/4150	354
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800
1	200	G.E.	IK	440	865
1	75/150	G.E.	IK	440	450/900
1	150	Whse.	CS	440	580
1	150	Wstghse.	CS856S	440	830
1	125	Whse.	MS	440	485
2	125	Al. Ch.	ARW	2200	1750
2	100	G.E.	IK	440	580
1	100	G.E.	IK-Vert.	2200	450

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
1	2200	G.E.	MCF	600	360/500
1	2000	Whse.	Mill	600	230/460
1	940	Whse.	QM R Brg.	250	140/170
1	900	Whse.		250	450/550
1	825	Whse.	Mill	250	90/180
1	600	A. Ch.	MILL	250	400/800
1	500	Whse.	Mill	600	300/900
2	450	Whse.		550	415
1	400	G.E.	MCF	550	300/1050
1	300/400	G.E.	DYNA	250	1325/2500
2	300	Whse.	CB-5094	230	575/1150
1	200/300	G.E.	MPC	230	360/920
1	250	G.E.	MPC	230	400/500
1	200	Rel.	1970T	230	720
1	200	Whse.	CB-5113	230	400/800
1	150	G.E.		600	250/750
8	150	Cr. Wh.	83H	230	890
1	150	Cr. Wh.	CMC-65H	230	1150
1	150	Whse.	SK-201	230	360/950
1	150	Whse.	SK-151 B	230	900/1800
1	125	G.E.	MD8-416	230	415
1	50/120	G.E.	MFC	230	250/1000
2	100	Whse.	SK-181	230	450/1000
1	60	El. Dy.	25-S	230	525/1050
2	50/60	Whse.	SK-170	230	400/1200
1	50	G.E.	CO-1810	230	725
1	50	Whse.	SK-170	230	350/1050
9	50	G.E.	RCP-31B	230	1700

MOTOR GENERATOR SET

3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	3000(3U)	G.E.	514	600	4000/13200
1	2000	G.E.	514	600	13800/4000
2	2000	G.E.	450	250	2400
1	2000 (25 cy)	G.E.	500	660	6600/11000
2	1750	G.E.	514	250	2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1500	C.W.	514	115	4160/13800
2	1000	Whse.	900	600	2300/4100
1	1000	G.E.	900	260	6600
1	1000(3U)	G.E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4150
1	750	C.W.	514	115	2300
1	600	G.E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	1200	125/250	2300
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	125	G.E.	1200	125	440
1	100	Delco	1200	125/250	440
1	100	G.E.	1200	250	2300/4000
2	35	Whse.	1750	125/250	2200

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1	12500	Whse.	60/25	13200x13200
1	3000	G.E.	25/60	4000/2300x2300/4000
1	2500	G.E.	25/60	2400x4150
1	2000	G.E.	25/62½	2300/4160
1	2000	Whse.	25/62½	2300/2300
1	1000	G.E.	25/58	4400/2300
1	500	A.C.	25/80	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	Moore	Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
	1000	G.E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
	750	G.E.	Condensing 425#-725#TT I.S.P. 440 V. 3 ph. 60 cy. New—1944
	750	Whse.	Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
	400	Whse.	Non-condensing 125/150# I.S.P. 5/10# G.B.P., 240/480v. 3 ph. 60 cy.
	300	G.E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V. 3 ph 60 cy.
	200	Whse.	Non-condensing 150# I.S.P. 7# B.P. 240 V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	33000x26400/13200
1	3500	G.E.	WCT	3	13800/6900x2300/440
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G.E.	HVDDJ	1	66000x13800
2	1750	G.E.	WCT	3	13800/6900x2300/410
3	1000	G.E.	H	1	2200x480
1	1500	G.E.	HT	3	13200x2300
3	1250	G.E.	H	1	6600x550
1	1150	A.C.	OISC	3	13200x2300/480
2	1000	Pitts.	OISC	3	2300x460
4	1000	Al. Ch.	OISC	1	2300/4000x460
3	1000	Wagner	OISC	1	13200x220/440
2	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OISC	1	11200x120/240
1	150	G.E.	HT	3	25000x120/208
3	150	Whse.	OISC	1	33000x2300/4000
2	75	Upte	OISC	3	4160x240

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W. U. WIRE • CABLE — AGSCOMACH

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1980	Nordberg	TS-217	3000	225
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
480	Worthington	DD-8	700	360
400	Ingersoll-Rand	S-8	600	720
350	Baldwin	VO-6	510	450
320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
250	Fairbanks Morse	33-D	375	360
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200

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STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
500(3)	1800	West.	Syn. 2200 V.	PedBrgW/Exc
450	1800	AC	SC 2200 V.	AW-SB
350	1800	AC	SC 2200 V.	AW-SB
200	1800	GE	SC	K6333S TEFC
150	1800	GE	SR	M-6328 TEFC
150	720	Allis-Chal.	SR	ARHoist
150	720	West.	SC	CS
125	3600	Elliott	SC 2200 V.	9NS02
125	1200	AC	SR	ARY-BB
100	900	GE	SR	MT-SB
100	1800	GE	SR	IM
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn 2200 V.	TS-DC Exciter
75	1200	Wagner	SC	24-W
75	900	West.	SR	CW-752C
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	GE	SC	I-K
60	3600	GE	SC	K 1448B
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
60	900	AC	SC 2200 V.	ARZ-TEFC
50	1800	GE	SC	IK
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	900	GE	SC	IK
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405sExp.Fr.
40	1800	GE	SC	KT
40(2)	1200	Rel.&West.	SC	Fr. 115-BB
40(2)	1200	ACé:Rel.	SC	TEFC-BB
40	900	West.	SR	CW
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC

SPECIALS

1—500 KVA Trans. West'hse Type ASL, 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.

735 So. 4th St., St. Louis 2, Mo. Phone — Chestnut 4601

LEA Offers You

M-G SETS—3 ph. 60 cy. Drive
1—750 KW G.E. 550V D.C. MPC., Syn. Dr.
1—500 KW G.E. 250V D.C. MPC., Syn. Dr.
7—400 KW West. SK. 125V. D.C.
2—200 KW West. SK. 250V. D.C.
2—150 KW West SK. 250V. D.C.
1—150 KW G.E. 250V. MPC.
1—100 KW West. SK. 125V. D.C.
2— 75 KW West. SK. 125V. D.C.
95 other A-DC Units

SQ. CAGE MOTORS 3 ph. 60 cy. 440 V
1—400 HP West. MS. 400 RPM

SQ. CAGE MOTORS
1—300 HP A.C. "AN" 1200 RPM
1—250 HP Ideal 600 RPM
1—150 HP A.C. T.E.P.C. 1800 RPM
1—150 HP G.E. I-K-17 450 RPM
500 Other Small Sizes

25 cy. 3/440 V SLIP RING MOTORS
1—800 HP, 1—600 HP
1—400 HP, G.E. 750 RPM
1—300 HP A.C. 500 RPM
1—225 HP G.E. I.T.C. 500 RPM
1—300 KVA Frequency Changer, G.E. ATI. 3 ph. 25 to 60 cy., or 60 to 25 cy. 440 to 440 V.

Controls for the above can also be supplied . . . 4000 other units in stock. Write us.

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CURRENT MODEL·· DIESEL

1980 KW NORDBERG MODEL TS-217 DIESEL UNIT

Heavy Duty • Slow Speed • Available Immediately

Will burn heavy bunker oil . . . Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21½" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake exhaust, water, lubricating oil, fuel oil, and air. Generator and exciter control switchgear.

The unit above affords a rare opportunity to procure a complete, modern current model, heavy duty, slow speed diesel set at a great saving. It represents an offering which cannot be duplicated anywhere in the diesel market today

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8000 Gal. Cement Lined Hot Water Heater
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A FEW SPECIALS

BOILERS

Cleaver Brooks model OB25, 8600 lbs. steam, 200 lbs. pressure, Oil fired. "1949"

Combustion Engr. Premier #30, 256 HP semi-portable, steel encased, firetube, 150 lbs. pressure "1949"

1000 H.P. Combustion, 4 Drum, 200#
812 H.P. (2) Combustion, 4 Drum, 300#
500 H. P. (2) B&W straight tube 200#
400 H.P. BW 3 Drum, 160# "1949"
250 H.P. BW 3 Drum, 225# "1948"

TURBO UNITS, non-condensing

937 KVA GE 480/240 v.; O/15# bp
625 KVA Al.Chal.-Elliott 480/240 v.; O/15# bp
375 KVA Al.Chal.-Elliott 240/480 v.; O/25# bp

STEAM ENGINE UNITS (Uniflow)

375 KVA (2) Wghse.-Skinner, 3/60/600 v.
312 KVA GE-Skinner 240/480 v.
250 KVA (2) GE-Skinner, 240/480 v.
187 KVA Wghse.-Ames vertical, 240/480 v.

DIESEL UNITS (Modern)

1136 KVA (4) FM, opposed piston, 720 rpm
1000 KVA Elliot-DeLa Vergne 200 RPM
438 KVA GE—Winton (General motors)
300 KVA Fairbanks Morse 277 rpm
220 KVA (2) Wghse-Buckeye "E" 400 rpm
187 KVA Ideal-Buckeye "E" 400 rpm
125 KVA (two) General Motors 1200 rpm

GAS ENGINE UNITS

250 KVA GE-Cooper Bessemer, 450 rpm, GS-6
750 KVA EM-Worthington, 360 rpm, DDG-8

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

POWER PLANT MACHINERY

TURBINE GENERATOR UNITS
3 Phase 60 Cycle

32,500 KVA G.E. Cond. 250 lbs. 12000/13200 volts.
12,500 KVA A.C. Cond. 250 lbs. 2400 volts.
7,500 KVA West. Cond. 170 lbs. 2400 volts.
6,250 KVA G.E. Cond. 175 lbs. 2400 volts.
5,000 KVA G.E. Non-cond. Extraction 600 lbs.-125 lbs. extr. 50 lbs. exh. 13800 volts.
5,000 KVA G.E. Cond. 400 lbs. 2400/4160 volts.
2,500 KVA West. Cond. 200/400 lbs. 2400 volts.
1,875 KVA G.E. Cond. 225 lbs. 480 volts.
1,563 KVA G.E. Cond. 150 lbs.-15 lbs. extr. 480 volts.
1,250 KVA West. (2) Cond. Extraction 250 lbs.-125 lbs. extr. 480 volts.
1,250 KVA A.C. Cond. Extraction 300 lbs.-25 lbs. extr. 240/480 volts.
938 KVA Terry Cond. Extraction 250 lbs.-45 lbs. extr. 480 volts.
938 KVA G.E. (2) Non-cond. 150 lbs.-20 lbs. exh. 480 volts.
625 KVA G.E. Non-cond. 300 lbs.-5 lbs. exh. 480 volts.
625 KVA West. Cond. Extraction 200 lbs.-20 lbs. extr. 480 volts.
250 KVA G.E. Cond. 150 lbs. 480 volts.
187 KVA West. Non-cond. 150 lbs.-15 lbs. exh. 480 volts.
150 KVA G.E. (2) Non-cond. 150 lbs.-7 lbs. exh. 240 volts.

STEAM BOILERS

150,000 lbs. per hr. (3) B.&W., 250 lbs. stoker coal.
50,000 lbs. per hr. B.&W., 450 lbs. pulv coal.
35,000 lbs. per hr. (2) B.&W., 400 lbs. stoker coal.
25,000 lbs. per hr. B.&W., 400 lbs. stoker coal.
15,000 lbs. per hr. B.&W., 200 lbs. oil fired.
10,000 lbs. per hr. Union., 160 lbs. oil fired.

DIESEL GENERATOR UNITS
3 Phase 60 Cycle

1,250 KVA Nordberg, 2400 volts 257 RPM.
1,000 KVA Alco, 480 volts 600 RPM.
875 KVA Worthington, 2400 volts 327 RPM.
650 KVA Superior, 2400 volts 327 RPM.
625 KVA Cooper-Bessemer (New), 480 volts 600 RPM.
500 KVA (2) Fairbanks Morse, 2400 volts 400 RPM.
450 KVA (3) Alco, 480 volts 514 RPM.
425 KVA Fairbanks Morse, 2400 volts 400 RPM.
400 KVA (3) General Motors, 480 volts 1200 RPM.
375 KVA (3) Worthington, 240 volts 327 RPM.
375 KVA General Motors, 480 volts 1200 RPM.
350 KVA (2) Fairbanks Morse, 2400 volts 300 RPM.
312 KVA Superior, 480 volts 360 RPM.
250 KVA Worthington, 240 volts 327 RPM.
219 KVA (2) Ingersoll-Rand, 2400 volts 600 RPM.
150 KVA Fairbanks Morse, 240 volts 360 RPM.
150 KVA Worthington, 240 volts 600 RPM.
125 KVA Hercules, 440/220/127 volts, 1800 RPM.
112 KVA (2) Cooper-Bessemer, 2400 volts 450 RPM.
75 KVA Winton (gasoline) 240/480/2400 volts 1200 RPM.
62 KVA International Harvester, 240 volts 1200 RPM.
37 KVA General Motors, 240 volts 1200 RPM.

UNIFLOW GENERATOR UNITS
3 Phase 60 Cycle

770 KVA Skinner horizontal, 150 lbs. 2400 volts.
750 KVA Ames vertical, 150-175 lbs. 240/480/2300/4160 volts.
500 KVA Skinner horizontal, 150 lbs. 240 volts.
375 KVA (2) Skinner horizontal, 150 lbs. 240/480 volts.
312 KVA Skinner horizontal, 150 lbs. 240 volts.
250 KVA Ames vertical, 150 lbs. 480 volts.
210 KVA Skinner horizontal, 150 lbs. 240 volts.
156 KVA Skinner horizontal, 150 lbs. 240 volts.

MOTOR GENERATOR SETS
3 Phase 60 Cycle

2,000 KW A.C. 2300 volts AC—250 volts DC. 720 RPM.
500 KW (2) West. 2300/4160 volts AC—250 volts DC. 1200 RPM.
300 KW G.E. 2300 volts AC—250 volts DC. 1200 RPM.
200 KW (3) West. 2300/4000 volts AC—250 volts DC. 600 RPM.
150 KW G.E. 2300/4000 volts AC—250 volts DC. 1200 RPM.
100 KW West. 2300 volts AC—250 volts DC. 900 RPM.

ROTARY CONVERTERS
3 Phase 60 Cycle

3,250 KW G.E. 13800 volts AC—250 volts DC.
1,500 KW (2) West. 13200 volts AC—250 volts DC.
500 KW West. 2300 volts AC—250 volts DC.
300 KW A.C. 13200 volts AC—250 volts DC.
150 KW (3) West. 6600/2300 volts AC—250 volts DC.

TRANSFORMERS
60 Cycle

10,000 KVA (1) A.C. 3 ph., 12000-2400/4160 volts.
3,500 KVA (1) West. 3 ph., 33000-13800 volts.
3,333 KVA (3) G.E. (New) 1 ph., 11000/33000-7200/12470/2400/4160 volts.
3,000 KVA (1) Stand. 3 ph., 33000-4160 volts.
2,125 KVA (3) G.E. 1 ph., 13200-2300/4000 volts.
800 KVA (3) Wgnr. 3 ph., 2400 4160-480 volts.
600 KVA (3) G.E. 1 ph., 22000/11000-2300/4000 volts.
500 KVA (3) West. 1 ph., 33000/22000-2400/4160 volts.
500 KVA (1) West. 3 ph., 2400-480 volts.
400 KVA (3) G.E. 3 ph., 69000-2400/4160 volts.
300 KVA (3) G.E. 3 ph., 6900-2400/4160 volts.
250 KVA (3) G.E. 1 ph., 2300/4000-115/230 volts.
150 KVA (3) G.E. 1 ph., 33000-7200/12470 volts
100 KVA (3) Pph. 1 ph., 7200/12470-120/240 volts.
25 KVA (3) G.E. 1 ph., 2300-230/460 volts.

Write, Wire or Phone For Further Details and Prices.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 1-9514 **CLEVELAND 14, OHIO**

Anything in ELECTRICAL EQUIPMENT

PARTIAL STOCK LIST — SEND US YOUR INQUIRIES

D.C. MAGNETIC STARTERS
230 Volts — New

90—15 HP Ward-Leonard, Type 17125

NEW MOTORS, 220/440/3/60— Ball Bearing

Q	HP	Make	RPM	Type
26	½	Reuland	1200	ML
15	¾	Reuland	1800	MLE*
21	¾	Reuland	3600	ML*
7	¾	Reuland	3600	MLE
15	1	Reuland	900	ML
18	1	Reuland	3600	MLE*
35	1½	Reuland	1800	ML*
10	1½	Reuland	1800	ML

* Total Enclosed

MOTOR GENERATOR SETS

Q	KW	Make	RPM	DC	AC
1	250	C.W.	1200	250	2300
1	150	Al.Ch.	1200	250	2300/440/220
1	150	W.H.	1200	250	2300
1	150	G.E.	1200	250	2300
1	90	G.E.	1200	125	440/220
2	50	G.E.	1200	125	440/220

D.C. MOTORS, VARIABLE SPEED

Q	HP	Make	RPM	Volts
2	7½	W.H.	400/1600	230
1	10	W.H.	400/1600	230
5	15	W.H.	500/1500	230
2	15	W.H.	550/1650	230

D.C. GENERATORS

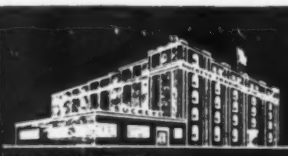
2—300 KW, W.H. 125 Volts—750 RPM
1—100 KW, W.H. 125 Volts—900 RPM

SLIP RING MOTORS

1—Al. Ch. 400 HP, 505 RPM, 2300 V Serial #110,844
1—Al. Ch. 400 HP, 1800 RPM, 2300 V Serial #941CH146D
1—W.H. 100 HP, 720 RPM, 440 V

MOTORS, GEAR HEAD, A.C.

7½ HP W.H. TEFC, 3/60/220/440-580 RPM-RB
20 HP Link Belt, Size DM70, 3/60/220/440 74 RPM-RB
20 HP W.H. TEFC, 3/60/220/440-194 RPM-RB
40 HP G.E. TEFC, 3/60/220/440-561 RPM-RB



BUCKEYE *Trading Corporation*

LARGEST STOCK IN MIDWEST

1019 PAPIN STREET CHESTNUT 3110 ST. LOUIS 2, MISSOURI

BOILER FEED PUMPS

1—Lecourtenay 675 G.P.M., Type 4M 8B, 5 stage, 1100 Ft. Hd.
1—Worth. 740 G.P.M., type WCS-2, 5", 2250 Ft. Hd.
1—Worth. 700 G.P.M., type UNS-1, 6 stage, 6", 1550 Ft. Hd.
2—I. R. 200 G.P.M., 2", 1375 Ft. Hd.

Pumps above are mounted on basis for motor or turbine drive.
We have about 200 various size cent. pumps on hand, turbine, motor, and gasoline driven. Send us your inq.

DALTON SUPPLY CO.
2829 Cedar St. Phila. 34, Pa.

USED 35 TON BRIDGE CRANE

75' span with 5 ton aux, 25' lift. Cab type 3/60/220 V. A.C.—used approx. 2 yrs. Mfg. Northern—*excellent condition.*

DAVE GORDON STEEL PRODUCTS, INC.
2411 35th St. Tampa, Fla.
P.O. Box 5033 Ph. 4-2367

RENTAL OR SALE
EXISTING
BOILERS
10 TO 5000 HP — 10 TO 900 PSI
EXISTING
DIESEL ENGINES — STEAM TURBINE
GENERATORS
5 TO 20,000 KW
DEAN G. STRICKLER & ASSOCIATES
5220 Pennington Ave., Baltimore 26, Md.
Curtis 7-2772

IMMEDIATE DELIVERY FROM STOCK !

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	6600	Westinghouse
350	3600	2200	Westinghouse
300	1200	2300/440	Westgh., CS
300	900	440	G.E.
200	490	2200	G.E.,-I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	1200	2300/440	A-C, AR.
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
50	3600	220/440	G.E.-404S
50	1800	220	Triumph
50	720	2200	Westinghouse
40	1800	220/440	West.-444
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.

*New Motors

4 SPEED MOTORS AND CONTROL

Century, Model SCNM504Y901AV, 20 HP, 440 volt, 3 Phase, 60 Cycle, 1700/1120/870/560 RPM. Multi-speed, ball bearing. With plugging switch mounted on shaft; motors on adjustable hinge bases. Control —Allen Bradley, Magnetic.

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-Cw
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	514	440	Al. Ch. 3 Brg.
250	600	2200	G.E.-117B
250	450	2200	C.-W.
250	450	2200	G.E.-I-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.

Special

FREQUENCY CHANGER

2500 KW General Electric
2300 volt, 3 phase, 25 cycle,
4000 volt, 3 phase, 60 cycle,
300 RPM.

200	600	440	West-CW
200	600	440	G.E.-1M
200	514	440	West.-CW
150	1800	2200	FM-HV
150	720	2200	Al. Ch.
150	600	220	Wagner
125	1750	2200	West., CW
120	900	550	Ideal
100	720	440	Al. Ch.
100	600	2200	G.E. MT-552
100	600	220	Wagner
100	400	440	West. Elec. (GE)

*New

MOTOR GENERATOR SETS

D.C. OUTPUT			A.C. INPUT		
KW	Voltage	Description	HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
1200	525	Al. Ch.-G.E.	2000	720	2300
800	500	West., 3 unit	1200	1200	2300
800	250	Westgh.	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
750	250	Westgh.	1070	900	13200
600	250	Westgh. (2-300 KW Gen.)	1200	1200	2300
600	250	G.E.	900	900	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.,-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.,-Westgh.	300	1200	440
100	250	Delco-Westgh.	150	1200	220
100	250	G.E.	150	1200	220/440
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
35	125	G.E.	50	1800	2200
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	33½	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440

PLATING AND ANODIZING SETS

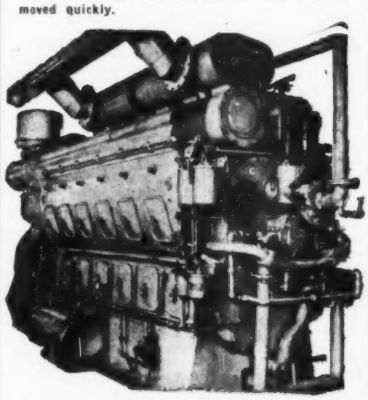
D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	A.C. END HP	VOLTS	DESCR.
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	200	440	WH Sync.
1500/750	6/12	1200	Munning Loeb	15	440	GE—1 Cage
1200	80	1160	Century	108	220/440	Century, SCN-584
1000	60	1200	Century	100	440	Century Cage
1000	6	1200	Wagner	—	—	—
800	30	900	C-W	40	220	C-W type 122Q
680	11	900	Westgh.	15	440	W.H. BB.
600	50	900	E-M	40	440	A-C
600	30	1200	W-E	30	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6		G.E. Rect.	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

MEMBER OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

Glow Electric Company

927 HARRIET ST. CINCINNATI 3, OHIO PHONE MAIN 3024

New Surplus Diesels for fraction of new price! Kept in heated storage space and in A-1 condition. Ready for immediate delivery as they must be moved quickly.



New 900 HP GM 12-567 with 600 KW—550 V D.C. Generator Westinghouse Type 486, 720 RPM.

New 300 HP Cooper Bessemer Model F-S-6 with 200 KW Gen. Elec. D.C. generator, 125 V D.C., 800 RPM.

Buda Gasoline Engine, Type C12, 75 KW, 240 V, 62.5 KVA, 1800 RPM. On 4 steel wheels with towing hitch. Complete enclosed cabinet unit. Used —in excellent condition.

ACME EQUIPMENT CO., INC.
126 South Clinton St., Chicago 6, Illinois
Phone: Andover 3-3430

NEW MOTORS! • STOCK SHIPMENT

ALL BALLBEARING

General Electric, Louis Allis, Reliance, Westinghouse. NEMA FRAME
Discounts from 60% to 65% Off on Items listed below.

25 CYCLE TEFC & EXPLOSION-PROOF (2G Label) 220-440 volts

Amt.	HP	Speed	Make	Frame
2	30	1500	Rel.	445
1	30	1500	G.E.	445
1	25	1500	Rel.	450
1	15	1500	L.A.	405S
1	15	1500	G.E.	404
3	10	1500	L.A.	364
5	5	1500	L.A.	284
1	5	1500	L.A. I-D	284

1/60/115-230 (1-D Label)

6	3	1800	L.A.	254
1	1½	1800	L.A.	225
1	1½	1200	G.E.	225
6	1	1800	L.A.	224

1/60/115/230 OPEN DRIP-PROOF

26	1	1800	L.A.	204
8	1	1800	Std. D.	203

2/60/220-440 OPEN DRIP-PROOF

1	10	1800	L.A. XP	326
1	7½	900	L.A.	326
2	5	1200	L.A.	284
3	1½	1200	L.A.	224
4	1	3600	L.A.	163
2	1	1800	L.A.	203

3/60/550—OPEN DRIP-PROOF

1	100	3600	G.E.	445S
13	40	3600	Rel.	404S
1	25	3600	G.E.	364S
5	5	3600	L.A. XP	225

BRAKE MOTORS

22	½	1800	L.A.	163

220/440 volts W/Size 5 C-H brake
Many larger brake motors also in stock.

3/60/220 GEARMOTORS

3—5/3.3/2.3/1.66 HP, 55/36/27/18 RPM, Whse. Frame FD324, parallel shaft output.

20—NEW Cleveland right angle worm gear reducers rated 5 HP—1150 RPM, 7.5 HP—1750 RPM, 6-1 Ratio, Series 215—50 RT Class 1

230 V DC

1	10	1200	Whse.	SK63
4	7½	1200	Elec. Dy.	324

10,000 Other Motors In Stock
FHP Thru 1000 HP, New and Rebuilt

BENSON-WILIMZIG, INC.

1708 North 8th Street **Garfield 4290** **St. Louis 6, Missouri**

PHONE — WIRE — OR WRITE

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	6000	G. E.	100	2300	90
2	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	1750	G. E.	100	2300	3600
1	750	G. E.	80	2300	450
1	600	G. E.	100	440	360
1	700	G. E.	80	2300	720
1	250	G. E.	100	2300	514
1	200	Whse.	80	440	1200
1	187	G. E.	80	440	720
1	150	G. E.	100	2200	900
1	150	G. E.	100	550	600
1	150	G. E.	80	220/440	450
2	135	G. E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G. E.	80	2200	900
2	100	Whse.	80	440	1800
1	100	Ideal	80	440	900
2	100	G. E.	80	440	600

With these we can supply—Manual, Semi on full magnetic reduced or full voltage control.

SQUIRREL CAGE MOTORS

3-Phase — 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806	2300	1200
2	400	G. E.	I-K	2200	v514
1	400	G. E.	KT-412	2200	450
1	300	Whse.	CS-860	2300	1780
1	200	Whse.	CS-873-C	2200	1200
1	200	Al. Ch.	ARY	440	600
1	125	Al. Ch.	AR	2200	1750
1	125	Al. Ch.	AR	2300	514
1	125	C. W.	126-Q	440	430
2	100	Whse.	CS-663-C	440	1750
1	100	Al. Ch.	AR	550	720
1	100	Whse.	CS-938	2200	514
1	100	F. M.	H-241	440	450
2	75	Al. Ch.	AR	2200	1705
1	73	G. E.	I-K	440	600
1	75	Al. Ch.	AR	2200	720

Special—1 (new) G. E. Vertical KF-574, 2200-Volt 580 R.P.M. enclosed hollow shaft.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1 (3-U)	2400	Whse.	720	600	4800/2400
1	1500	G. E.	600	600	4160/2300
3	1000	Whse.	514	600	11,000/6600
2	1000	G. E.	514	600	11,000/6600
1	750	Whse.	900	250	4160/2300
2	500	C. W.	720	575	2300/440
1 (3-U)	500	Whse.	1200	125/250	440
1	400	C. W.	1200	125/250	440
2	250	Whse.	1200	125/250	2300/440
1	200	Whse.	1200	275	4000/2300
1	200	Whse.	1200	125/250	4000/2300
1	155	G. E.	720	250	2300/440
2	150	Whse.	1200	125/250	440
1	100	Delco	1200	125/250	440/220
1	100	Ridgeway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	85	C. W.	1200	250	440/220
1	75	Al. Ch.	900	250	2300
1	75	Whse.	900	240	2300
1	25	Ideal	1750	125	440/220
1	25	Al. Ch.	1200	250	440/220
3	20	Al. Ch.	1200	250	440/220
2	15	Al. Ch.	1200	250	440/220

We can furnish any of these sets with D. C. panels, A.C. starting equipment, exciter sets and other accessories.

Motor Generator Sets of modern design, complete with control—still on their original foundations—available for immediate shipment.
(3)—G. E. 1500-KW, 250-VDC, 514 R.P.M., cpd., interpole, pole face windings, 2100-HP syn. motors, .8-PF, 13-200-V, 3-p, 60-cy. will reconnect to 6600-V. or 4160-V.

TRANSFORMERS (Power)

Outdoor — Oil Cooled

Qu.	KVA	Make	Type	Phase	Voltage
3	250	Packard	A	1	13200-2200
3	150	Packard	A	1	2300-230/460

3—833-KVA Westinghouse O.I.S.C. transformers, type S, one phase, 60 cycle, still on original foundation, primary 66,000 Volts with (4) 2½% taps below secondary 2300/4160-Y. Can ship immediately from location.

SLIP RING MOTORS CONSTANT DUTY

3-Phase — 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	1800	G. E.	MT 498	2300	357
1	1200	G. E.	MT 26	2200	277
2	1000	Al. Ch	ANY	2200	235
1	800	G. E.	MT	2200	440
1	600	G. E	MT 20	2300	360
1	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
1	400	G. E.	MT 412	2200	440
1	250	Whse.	CW 937	440	1200
1	250	Al. Ch.	ANY	440	720
1	250	G. E.	MT 414	2200	300
1	125	Whse.	CW 870	2200	900
1	100	Whse.	CW 766	440	1200
1	100	F. M.	H 20 C	440	900
2	100	G. E.	I-15A-M	2300	514

DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	R.P.M.
1***	3000	Whse.	Encl. (Rev.)	600
1***	2400	Whse.	Encl. (Rev.)	600
4***	1500	Whse	Encl. (Rev.)	600
4***	1200	Whse.	Encl. (Rev.)	600
4***	800	Whse.	Encl. (Rev.)	600
10**	700	Whse.	Mill	285/720
1	350	G. E.	CD-169	1150
1**	250	G. E.	MPC-6	325/975
1**	200/250	El. Dy.	Size 22	400/1200
1**	200	Whse.	Mill	300/1200
1**	200/250	G. E.	MPC	300/900
1**	180	G. E.	MPC	400
1***	125	Whse.	SK-190	600
1**	90/160	G. E.	MPC	625/1125
2	125	Whse.	SK-184	575/850
1	75	G. E.	CD-133	500/1000
1	60	El. Dy.	25-8	450/900
1	50	G. E.	RF-16	300/900
1	50	Whse.	SK	250/1000

All above are 230-VDC except where marked ***
***—Pedestal bearing mill type 525/600-VDC.
**—Pedestal Bearing 230-VDC.

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—20,000 KW 200# 13,200 V.
1—10,000 KW 200# 13,800 V.
1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext 170# Non Cond.
1— 3,000 KW 175# 550 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,250 KW 250# 2400 V. Ext.
1— 1,000 KW 200# 4160 V. N.C. NEW 1949.
2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 300 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS

1—1000 KVA 2100 volts
3— 500 KW 480 volts
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS

2—50,000# 275# (1949)
3—15,000# 275# (1945)
1—400 HP Sec. Hd. 22?#
1—300 H.P. 300# (1948)
1—84" HRT 150# (1942)

WATER WHEEL GEN.

1—180 KW 2u F. H. 550 V.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

FOR SALE
TELESCOPIC ASH HOIST

POTTS MODEL D-3 electrically operated, telescopic Ash hoist, equipped with 1½ H.P., 3 phase, 60 cycle 220 volt motor, magnetic brake, upper limit switch and single lever control switch.
Will raise 13'3" fed from basement floor to sidewalk.
Will raise 3'6" above sidewalk for dumping on truck.
Never used because of changed parking ordinance preventing unloading.
Will sacrifice for $350.00 our building basement.

UNION BUILDING COMPANY
DAVENPORT, IOWA

FLUID DRIVE · GYROL TYPE VS
● HYDRAULIC COUPLINGS ●

Stepless speed variation with constant speed prime mover made by American Blower Co. Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers, rotary kilns, etc.
Wide range of capacities—Condition 98% new
200 HP to 2500 HP Input
300 RPM to 900 RPM Input
Complete data & quotation on request.
Also large selection of marine couplings, reduction gear, & Falk grid type couplings in stock.

A. G. SCHOONMAKER CO., INC.
50 CHURCH ST., NEW YORK 7, N. Y.

STOKERS
#75 Complete

2 Holcomb & Hoke Firetenders
Hopper Capacity, 500 Pounds
Motors 3 h.p., Fan 3 h.p.,
Screw ¾ h.p.
20,000 Sq. Ft. Radiation
Coal Burning from 100 Pounds to 750 Pounds per Hour
Boiler h.p. 150

These Stokers Are in Best of Condition, Carefully Serviced.

NEWARK NEWS
Engineering Department
Newark, N. J. **MArket 4-1000**

BOILERS

15,000 & 10,000# Steam/hr. B&W WT
500 HP 600# B&W WT—New 1946
300 & 400 HP Wickes Low-head WT
250 HP Kewanee; 80 HP Economic
160 HP 125# Dutton Package—NEW
15 HP Gas; 10 HP Oil; 100# P.

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FOR SALE

4,000 feet 3 conductor 500,000 CM 8stranded oil base rubber, shielded, insulated for 5,000 volt with ground wires, Neoprene Jacket overall made by General Electric consisting of two pieces 700' each and 563', 425', 276' and 170'.

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New and Used Equipment Available for
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APPARATUS EXCHANGE — Two Rector St., New York 6, N. Y.

FOR SALE

One Used Westinghouse
LEBLANC CONDENSOR

Size 11—Ser. #450 Low Level Jet with 75 HP Motor.

FS-8664, POWER
330 W. 42 St., New York 36, N. Y.

O'Brien Offers—

MOTOR GENERATOR SETS

1500 KW G.E. 250 Volt 3/60/2300/360 RPM
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

BOILERS

2—500 HP Cleaver Brooks Package 200 lb.
1—450 HP Keeler CP 160 lb. Oil
1—300 HP Keeler CP 300 lb. Oil
2—200 HP Springfield Sec. Hdr. 300 psi.
1— 80 HP Cleaver Brooks Package 125 psi
1— 60 HP Cyclotherm Package 125 psi

Space Needed—Priced for quick sale—3—250 KVA GE Ames Vertical 4 cylinder Uniflow engines, 3/60/240/400 rpm, 140 psi, 5 lb. back pressure, Exciters, Switchboards, Condition Excellent—Contact us to inspect at Claridge Hotel Atlantic City, N. J.

DIESEL GENERATOR SETS

1—1250 KVA Nordberg 3/60/2300/360 RPM 1940
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 KVA Hercules. 3/60/220/440/1500 Hrs.
2—45 KVA Chry. New 6 Cyl. 3/60/220/440.
1—200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CW	440	1800
1	600	West.	CS	2200/4160	600
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	250	G.E.	IM	2300	450
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3.brg.	550	600
2	100	G.E.	KT352	220/440	1200
1	100	G.E.	KT543	440	1800
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

EXCEPTIONAL DELIVERY
New O'Brien mfrd. Red Line dry type Transformers to 150 KVA single phase, 300 KVA, 3 phase—4800 V. Pri.—& Phase Changers to 100 KVA.

TURBO GENERATORS
Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 p 50 lb. B.P.
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440. 150 PSI 10 lb. B.P.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

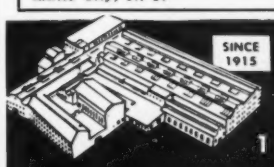
1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—528 CFM Ing. Rand 14x12, 100 psi.
1—215 CFM Penna 3A, 70 psi—V-Belt
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7½x5x4, 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
4	2000	West. (Sub-sta)	23000	2400 (NEW)	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. (Dry)	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	333	(New)	2400	480	1

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

"Everything from a Pulley to a Powerhouse"



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COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

1—2000 KVA, 3-60-33000-4160Y Westinghouse type CPS self-contained substations.
1—450 KVA, 3-60-13200-115/230 V. G.E. substation.
6—Section NEW G.E. switchboard consisting 2000, 600 and 350 A. drawout air breakers.
700 & 450 HP, 180 rpm, 4160V-3-60 UNUSED Syn motors.
1—37½ KVA-240/480 V.-3-60 Cat. Diesel set.

H. BLAINE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

MOTOR GENERATORS

2—500 KW Westgh. 4160/2300—275 v—1200 rpm
1—150 KW G.E. 4000/23000 v—250 v—1200 rpm
2—150 KW Westgh. 2200 v—275 v—900 rpm

AIR COMPRESSORS

1884 ft. CHICAGO PNEU. OCE 2300 V.
676 ft. WORTHINGTON 3/60/220/440 V
3—JOY 445' & 512'—220/440 V

DARIEN, 60 E. 42nd Street, New York, N.Y.

NOW LIQUIDATING
AT MARION, INDIANA

8—Welded Steel Storage Tanks (closed) 10,500 gal., 11,300 gal. and 12,700 gal.
1—Steel Shell & Tube Heat Exchanger, 1000 sq. ft.

FOR SALE FROM PHILA. STOCK

2—I-R Motorblowers, type FS-538; cap. 4000 CFM @ 3# Pr.
1—Byron Jackson Bronze Deep Well Turbine Pump with 20 HP motor. 150 GPM.
1—I-R #1½-RVH Bronze Centrifugal Motorpump with 20 HP motor. 200 GPM—200'.
1—Centrifugal Pump, 6" x 5", 40 HP 3/60/220 motor, 1000 GPM—88'.

PERRY EQUIPMENT CORP.
1422 N. 6th St. PHILA. 22, PA.

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100 KW General Motors Model 3-268A, A.C. & D.C. units. Rebuilt
60 KW G.M. Model 6-71. Rebuilt A.C. & D.C. Gen. sets.
Various types & sizes in Stock

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

TRANSFORMERS FOR SALE

3—1000 KVA Mol	11500—2400/4160Y
3— 500 KVA G-E	22000—2300/4000Y
3— 333 KVA W-H	13200—2400/4160Y
3— 333 KVA W-H	6600—2300
3— 333 KVA Mol	7200/12470Y—2400/4160Y
3— 250 KVA G-E	6600—575
3— 150 KVA G-E	19050/33000Y—2540/4000Y
2— 150 KVA G-E	6900—230/460
3— 100 KVA G-E	33000—6900—11950Y
3— 100 KVA G-E	4000—115/230
3— 50 KVA A-Ch	33000—6900/11950Y
3— 50 KVA A-Ch	33000—2400/4160Y

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
CINCINNATI 27, OHIO

40 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
600	2300	Whse.	450
500	440/220	Whse.	720
500	2200/4000	G.E.	900
450	440	Whse.	514
300	440	G.E. (hoist)	600
300	2200/440	Whse. (new)	600
300	2200	G.E.	360
300	440	Whse.	3600
250	4000/2300	G.E.	450
250	440/220	Whse.	600
250	550/440	G.E.	1200
250	440	G.E.	600
200	440/220	Whse.	514
200	440	G.E.	450
188	4000/2300	G.E.	1800
150 (2)	440/220	G.E.	720
150	2200/440	G.E.	600
150	550/220	G.E.	720
145	4000/2300	G.E.	1800
135	440/220	G.E. (hoist)	600
125	440/220	G.E.	900
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	2200/440	G.E.	ATI	720
350	440/220	El. Mchy.	Syn.	1200
350	440/220	Whse.	HR	900
300	2300/460	G.E.	TS	720
300	2300/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
240	2300/440	G.E.	ATI	720
225	440/220	Whse.	HR	360
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2200	G.E.	PT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
350	2200	G.E.	KT	1200
300	2200	L. Allis	PS	1800
300	2200	G.E.	PT	3600
250	2200/440	G.E.	IK	720
225 (2)	2200/440	G.E.	KT	1200
200	2200/440	G.E.	K	1200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	IK	600
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G.E.	IK	450
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/2200	G.E.	IK	514
150	2200/440	G.E.	KT	600
125	440/220	G.E.	KT(vert.)	1200
100	2200/440	G.E.	K	1200
100	220/440	G.E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-proof	1800
50 (2)	440/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	ARZZ X-proof	600/1200

A. C. GENERATORS

1—220 kva, 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 V., G.E.
1—225 kva, 600 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm, 2200/440 V., GE. (Ball brg.)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp., GG E., 3 pole, 600 v
2—1600 amp. ITE 3 pole, 600 v

D. C. MOTORS

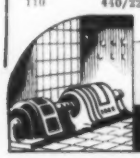
HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
250	230 (2)	G.E.	CD	1750
150	230	Whse.	SK	850
100	230	Cr. Wh.	CMC	825
90	230	G.E.	CD	1750
80	230	G.E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440	sq. ca.	250
100	Al. Ch.	2200/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G.E.	2200/440	syn.	125
65	G.E.	2200/440	sq. ca.	250
65	G.E.	2200/440	sq. ca.	125
60	G.E.	440/220	sq. ca.	250/125
45	G.E.	440/220	sq. ca.	250
40	G.E.	440/220	sq. ca.	250/125

TRANSFORMERS 60 CY.

3—200 kva, G.E., 11000—2300 V.
3—200 kva, G.E., 4150—480/240 V.
3—150 kva, G.E., 33000—2300/4600 V.
3—150 kva, Al. Chal., 2400—240/480 V.
3—150 kva, Al. Chal., 2400-240/120 V.
3—100 kva, Whse., 2400-240/480 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3—75 kva, Whse., 2400—240/480 V.
3—75 kva, Moloney, 4150—240 V.
3—50 kva, Whse., 440—220/110 V.,
6—50 kva, G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/220 V., dry



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HARRY J. RICE PRES.

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STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.
1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.
2—8000 HP Webster Water Heaters.
1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.
6—Steel Coal Bunkers, 80 tons each.
1—30" Wheeler Single Stage Circulating Pump, 30,000 GPM direct connected to 300 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)
1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam turbine.
1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis Steam Turbine, 2-stage with reduction gear, Type SO, 3600 to 1200 RPM.
1—Type 1A-60 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-Stage Steam Turbine, 1750 RPM.
1—6" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-Stage Steam Turbine, 1800 RPM.
1—Combination Circulating Pump and Condensate Pump driven by 190 HP General Electric single Stage Steam Turbine through a Westinghouse Reduction Gear, 3500 to 700 RPM.
1—2" 2-stage LeCourtney Centrifugal Pump, 200 GPM 850' Heat at 3700 RPM direct connected to 53 HP Westinghouse Steam Turbine.
1—3000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 250 RPM, 600 Volts DC with 1—3150 KVA General Electric Transformer, 3 phase, 25 cycle, 6600/13200-445 Volts with starting panel and all instruments.
1—1000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 750 RPM, 600 Volts DC with 1-1050 KVA General Electric Transformer, 3 phase, 25 cycle, 13200 445 volts with starting panel and instruments.
1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.
1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 13200/6600 volts.
7—700 KVA Westinghouse Transformers, single phase, 25 cycle, 7620/6600 volts to 13200 volts.
1—Kennecott Pressure Type Industrial Water Filter.
1—50-Ton Electric Traveling Crane—55'5½" Span.

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MORSE BROS. MACHINERY COMPANY

2900 BRIGHTON BLVD.

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2—75 KW GENERAL ELECTRIC 3 WIRE M.G. SETS

GENERATOR: 75 KW, type CD 1242, 250/125 volts, 1200 RPM, Compound Wound.

MOTOR: 125 HP, type K-5362, 3 phase, 60 cycles, 220/440 volts, 1200 RPM, Squirrel Cage.

Complete with DC Panels & AC (220 volts) Reduced Voltage Automatic Starters.

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MOTORS · MG SETS

All guaranteed for one year.

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
26	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600	600/900 RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	220	250/500 RPM
1	400	G. E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.

Smaller sizes also in stock.

Motor Generator Sets in Stock
100—2000 KW Capacity

All of above is modern late type equipment remanufactured & tested by our engineers.

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Plants: SAUSALITO (S.F.) CALIF., JERSEY CITY, N.J.

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IMMEDIATE DELIVERY
COMPLETE 1000 KW
Diesel-Electric Generating Plant.

Consisting of 4—250 KW Fairbanks-Morse engines with direct connected 2300 V generators. Includes switchboard, station service transformers, fuel storage tanks (20,000 gal. capacity), transfer pump and all other accessories. If interested, contact:

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Telephones Hughesville 70 and 71

175 HP BOILER

Vogt Boiler with Riley Stoker and complete with all fittings, etc. Used very little and in excellent condition. Priced low for quick removal. Located at Cleveland, Ohio.

HARRIS WRECKING CO.

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Diesel and Gasoline 1 to 1000 KW
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MOTORS • GENERATORS • TRANSFORMERS

T.E.F.C. MOTORS

2—200 HP West. XP-3/60/2200/3600, Frame 8120H.

1—125 HP G.E., TEFCBB, Frame KF63282, 60/3/440/3600 RPM.

1—60 HP Westinghouse X Proof, 3/60/220/440/875

60 HP West. CS-607 3/60/440/900, X-Proof.

1—50 HP Ideal TEFC, BB, 3/60/220/440/1800

50 HP Ideal, New, 3/60/220/440/1800.

1—30 HP Delco, TEFC, BB, 3/60/220/440/1745

1—25 HP G.E. TEFC, BB, 3/65/220/440/1750

1—25 HP G.E. TEFC, BB, 3/60/220/440/1170

2—20 HP Louis Allis ES-365, 3/60/220/440/1800, X-Proof.

1—20 HP Louis Allis, X Proof, 3/60/220/440/1750

15 HP Louis Allis Ex-364, 3/60/220/440/1800, X-Proof.

15 HP Louis Allis, X Proof, 3/60/220/440/1750

1—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP G. E. Type KT 3/60/440/600 RPM.

250 HP G.E. Type KT 3/60/440/720 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

55" LIFTING MAGNET

1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

TRANSFORMERS

1—750 KVA Niagara New. Outdoor. 3/60/2400/208Y/120

3—500 KVA Westinghouse Type SL 1/60/33000/2400/4160Y—New 1947.

3—333 KVA Westinghouse O.I.S.C. 1/60/4800/480

6—50 KVA Niagara New—Day Type 1/60/240/480—120/240

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3 — WORTHINGTON VERTICAL DIESEL ENGINES
EXCELLENT CONDITION

1—60 H.P. at 600 R.P.M. Mod. BB 2 cylinder 8x10½ Heavy Duty Engine, complete with outboard bearing, lubricating system, fuel and industrial oil filters, exhaust pipe with silencer and engine stand. Sr. #VO-1306

1—120 H.P. at 600 R.P.M. Mod. BB 4 cylinder 8 x 10½ Heavy Duty Engine, complete with two-stage gas or electric starting Air Compresser with 24" x 56" pressure tank also lubricating system, fuel and industrial oil filters, exhaust pipe with silencer and engine stand. Sr. #VO-1305

1—210 H.P. at 514 R.P.M. Mod. CC 3 cylinder 10¾ x 14½ Heavy Duty Engine, complete with outboard bearing, two-stage gas or electric starting Air Compressor with 24" x 56" pressure tank also lubricating system, fuel and industrial oil filters, exhaust pipe with silencer and engine stand. Sr. #VO-1304

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4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

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408 DONOVAN BLDG.
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AMERICAN REBUILTS LAST LONGER BECAUSE THEY ARE REBUILT BETTER

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60 CFM Worthington (Gas) 2 PNEU
70 CFM Smith (Gas) 2 PNEU
105 CFM Worthington & Ingersoll
160 CFM Worthington (Gas) 2 & 4 PNEU
210 CFM Worthington (Gas & Diesel)
315 CFM IR & Worthington (Gas & Diesel)
500 CFM Worthington (Diesel) 4 PNEU
600 CFM Worthington (Diesel) 4 PNEU

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Since 1902

We have a unit for your requirements from our stock of over **300** compressors & vacuum pumps.

STATIONARY

CFM	PSI	SIZE	MANUFACTURER
44	150	5x5	Ingersoll ER-1
66	110	6x5	Penn-IR
69	125	6x6	Ingersoll ER-1
88	60	7x5	IR-Penn
93	100	7x6	American-IR
122	100	7x7	Worthington-IR
136	125	8x8	American-IR
161	60	8x7	Ingersoll ES-1
166	135	8x9	IR-Worthington
187	40	10x6	Chicago NSB
211	100	9x9	Worthington HB
254	125	10x10	Chicago Pneu.
262	75	10x9	Worthington-HB
294	125	10x11	Ingersoll ES-1
311	40	12x8	CPT-Penn-IR
364	20	12x7	Worthington-IR
368	100	12x10	IR-CPT
379	40	12x9	Worthington HB
386	115	12x12	Ingersoll ER-1
426	100	12x11	Ingersoll ES-1
503	60	14x10	IR-Sullivan
528	100	14x12	CPT-IR
622	100	14½x13	American AF-1
740	40	17x10	CPT-IR
780	55	17x12	Ingersoll ER-1
868	125	17/10x12	Chicago Pneu.
1084	30	20x12	IR-CPT
1180	125	18/11x10	Chicago

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2—350 HP, 375-750 RPM, 230 V., MDP-422 Mill Motors w/blower and fan.

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3-unit synchronous motor generator set—suitable for 60 cycle

1—1250 KW, 750 RPM, 600 v., shunt wound DC gen. 40°C rise

1—750 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—3000 HP, 750 RPM, 6000 v., 3 ph., 50 cy., .8 PF, 40°C rise

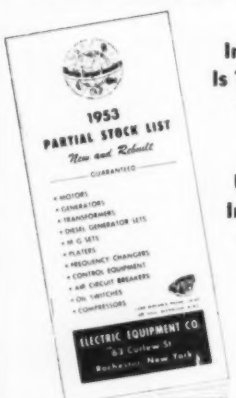
3-unit synchronous motor generator set—suitable for 60 cycle

1—400 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—750 KW, 750 RPM, 250 v., shunt wound DC gen. 40°C rise

1—1750 HP, 750 RPM, 6000 v., 3 ph., 50 cy., .8 PF, 40°C rise

Control equipment for the above is available. Your inspection is invited.



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ELECTRIC EQUIPMENT CO.

ROCHESTER 1, N. Y.

Phone LD 65

ENGINE GENERATORS

To be sold to best offer received BEFORE SEPT. 15

One 250 KW Skinner Unaflow engine-generator directly connected to Crocker Wheeler 125 volt D.C. generator. 200 RPM.

One 150 KW Ridgeway Corliss engine-generator directly connected to Thompson Ryan 125 volt D.C. generator. 200 RPM.

Two 75 KW Skinner Counter Flow engine-generators directly connected to a Westinghouse 125 volt D.C. generator. 265 RPM.

Equipment stands on original foundation, in running condition having been replaced by central station A.C. service. Also available is a large number of 120 volt D.C. various size motors, fans, etc.

MUST CLEAR THIS SPACE—MAKE AN OFFER!

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BINGHAMTON PRESS, INC.
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NORDBERG 1,000 HP DIESEL ENGINE

Type TA-174, Four Cylinder, with complete auxiliaries such as pumps, coolers and starting air equipment.

Coupled with:

Crocker Wheeler 700 KW —DC Generator

Installed New in 1940

New Cost: $175,000

OFFERING PRICE: $15,000

NO REASONABLE OFFER REFUSED BUILDING SOLD

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Inspection Can Be Arranged By Appointment

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16—200 KVA, 2300x115-230 volt Pittsburgh transformers at $500.00 each, guaranteed. Discount on quantities.

Transformers various voltage, motors all sizes in stock.

Special bargain on 1000 KW, 3ϕ Gen. Elec. turbo generator good up to 300 lbs. Pressure.

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Four drum, bent tube, complete with brickwork, broaching and catwalks. Each equipped with type "E" stokers. Complete forced draft equipment, steam flow-meter and ELLIOTT non-return valves. Set up for 250 pounds p.s.i. Capacity 50,000 pounds of steam per hour.

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3—G.E. Type CDM, Frame 66, 2.5/5 H.P., 230 Volts D.C., 1400/1750 RPM, Stabilized Shunt

P.O. Box 89, Brooklyn 11, New York

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2—250 H.P., 170 KW, 400 rpm, 5 cyl. Worthington

1—125 h.p., 100 KW, 600 rpm, Columbia Electric Generators and Switch Board

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40,000-KW TURBO-GENERATOR SET

Together with its steam generators and auxiliary electrical and mechanical equipment. Now in service but available for removal late this year.

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1—900 HP Springfield sectional header boiler, 400# W. P., 1926, A.S.M.E., Oil Burner equipment, deaerating heater, feed pumps. New Mexico.
2—824 HP Sterling Boilers, 1930, active certificate for 300# W. P. chain grate stokers, ELESCO superheaters, all auxiliaries, Austin, Minn.
2—750 HP, B. and W. Sterling type boilers, 225# W. P., 1925, A.S.M.E., oil firing equipment, all auxiliaries, New Mexico.
2—600 HP, B. and W. longitudinal drum, sectional header boilers, 1922, A.S.M.E. 200# W. P. Peabody oil burners, steel headers, New Jersey.
2—500 HP, B. and W. Boilers, 1916, retubed 1925, 209# W. P. Lawrence, Mass.
1—490# Walsh-Widener Cross Drum, Sectional Headers, 4" tubes, 1927, 450# W. P. all auxiliaries. West Point, Virginia.
1—400 HP Keeler C. P. Boiler, 1942, 160# W. P. new tubes and refractory, TODD mechanical oil burner and pump set. Overhauled, dismantled. Ready to ship. N. Y.

Complete plant consisting of:
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2—400 HP, B. and W. sectional header boilers, 200# W.P., steel headers, A.S.M.E., 1921, South Bend, Indiana.
1—310 HP Keeler C. P. Boiler, 160# W. P. 1942, pressure parts ship in one piece. Lake City, Florida.
1—300 HP Keeler C. P. Boiler, 160# W. P., 1942, all auxiliaries. Milton, Pa.
2—250 HP Erie City, 3 Drum, Low Head Boilers, 1946, 200# W. P. Brick Set, fully automatic PEABODY BURNERS and auxiliaries. West Hanover, Mass.

PACKAGE BOILERS

1—500 HP CLEAVER-BROOKS, 150# W. P., 1947, No. 6 oil, pump set, New Jersey.
1—400 HP CLEAVER-BROOKS, 150# W. P., 1949, fully automatic, No. 6 oil. N. J.
2—350 HP Preferred Utilities Steam Generators, 200# W.P., 1948, fully automatic, No. 6 oil, Washington, D. C.
Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.
A number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.
2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating.
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3—Elliot Surface Condensers, 1—900 sq. ft. 2—600 sq. ft. Located in New Jersey.
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Cross Drum Sinuous Headed straight tube type. Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

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ASME code—from ATR tug—built 1943. 15,000 lbs. steam/hr./unit (normal) 18,000 lbs. steam/hr/unit max. Design pressure—268 lbs/sq. in. —total steam at drum outlet (saturated) 409 —forced draft—turbine driven blowers—1508 sq. ft. boiler heating surface. Gas or oil.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(1) 30 KW G.M. 3-71 DIESEL GEN.

GM 4½x5 2 cyl. diesel—radiator cooled—electric starting. Delco 440/3/60 generator—with switchgear. Skid mounted—portable.

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.

Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stablized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL

510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

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50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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Curtis 7-5050

POWER EQUIPMENT

TURBINE UNITS

1—5000 KVA G.E. 3/60/2300/4000 V. 3600 RPM STRAIGHT CONDENSING nozzled for 450 psig 750° TT Surface Condenser.
1—1250 KVA Al. Ch. 3/60/480 V. 3600 RPM. Terry EXTRACTION turbine nozzled 250 psig 550° TT 40,000# extr. 25 psig. Surf. Cond.
1—938 KVA West. 3/60/480 V. 3600 RPM Terry EXTRACTION turbine nozzled 250 psig 500° TT 10,000# extr. 50 psig. Surf. Cond.
1—375 KVA G.E. 3/60/480 V. 3600 RPM. NON-CONDENSING nozzled for 150 psig. 5-10 psig back pressure.

BOILERS

1—50,000# Edgemoor bent tube 225# WP 490° TT Coxe chain grate stoker and economizer. New 1939.
2—502 HP Heine water leg type 200# WP 480° TT Coxe chain grate stokers. New 1929.

DIESEL & GAS ENGINE UNITS

1—2000 HP Fairbanks Morse 6900 V. 60 cy.
1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1— 275 HP Ing. Rand. 240 V. 60 cy. (Gas)
1— 250 HP Buckeye 240 V. 60 cy.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	V.—DC	A.C.	RPM
1	3000	G.E.	250	13200	514
1	1500	G.E.	600	4150	600
2	1000	West.	660	4150	900
1	200	West.	275	2200	900
2	150	G.E.	250	2300	1200
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS

QU.	HP	MFR.	VOLTAGE	RPM
2	2000	West.	13200	1200
1	900	A.C.	2200	180
2	700	West.	2300	200
1	600	G.E.	2300	240
1	300	G.E.	2300	600
1	300	West.	2300	900
1	200	G.E.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
2	6875	West.	25/62½	375
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300

OIL CIRCUIT BREAKERS—Outdoor

4— 800 A. 132 KV West. G-222A-2500-MVA
1— 400 A. 73 KV Condit FO-40-250 MVA
2— 400 A. 37 KV G.E. FHKO-136-350 MVA
4— 600 A. 15 KV G.E. FHKO-139-750 MVA
1—1200 A. 15 KV G.E. FKO-139-350 MVA

TRANSFORMERS

4—	2500 KVA Mel.	6900—13800
4—	500 KVA West.	6900—6900
3—	400 KVA G.E.	66000/33000—2300/4160
1—	150 KVA Mel.	44000—2400/7200
3—	75 KVA West.	44000—7200/12470 Y—
4—	5000 KVA G.E.	40635/70900 Y—14500
3—	3333 KVA G.E.	33000/11000—2400/7200
4—	333 KVA G.E.	33000—7200/12470 Y
3—	200 KVA A.C.	33000—2400/7200/12470
3—	100 KVA West.	33000—240/480 NEW
2—	75 KVA Wag.	33000—7200/12470 Y
4—	1500 KVA A.C.	25400/44000—6900/13800
4—	450 KVA A.C.	25410/44000—13280/23000
3—	1250 KVA G.E.	23000—2300/4000
3—	100 KVA G.E.	22000—7200/12470 Y
1—	300 KVA Stand.	19050/33000—4160, 3 ph.
1—	5000 KVA Pitts.	13200—4600, 3 ph.
1—	600 KVA Stand.	13200—2300, 3 ph.
1—	450 KVA Penn.	13200—2400, 3 ph.
3—	250 KVA West.	13200—240/480
3—	200 KVA G.E.	13800—2300
3—	250 KVA Pitts.	7200—220/440
3—	100 KVA G.E.	7200—240/480
3—	150 KVO Wag.	6900—2300
3—	37½ KVA G.E.	6900—230/460
4—	150 KVA G.E.	4800/2400—240/120
3—	333 KVA G.E.	2300—230/460
3—	250 KVA G.E.	2300/4000 Y—115/230
3—	200 KVA West.	2400—240/480
3—	150 KVA West.	2400—230/115
1—	100 KVA G.E.	2300—575, 3 ph.
3—	75 KVA A.C.	2400—240/480
6—	50 KVA West.	2400—114/228 Dry Type

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- Special constructions. Odd lengths.
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- Cut to length. Reasonably priced.

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2085' #12 Str. 3/C AVC Type TAVIB-6 Bronze armored impervious sheath
1015' 3/0 Motor lead wire str. 600 volt
580' 350 MCM 1/C VCB5KV
7365' #6RC 600 V Str. type Buna-S

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Port Edwards, Wisconsin

FOR QUICK DELIVERY

2—512 HP ea. B&W Co. 4 Drum Stirling Boilers 200#

1—768 HP B&W Co. 4 Drum Stirling Boiler 200#

2—1050 HP ea. B&W Co. Sectional Header Cross Drum Boiler 250#

2—2000 HP ea. B&W Co. Sectional Header Cross Drum Boilers 250#

CHARLES B. REARICK
30 Church St. New York 7, N. Y.

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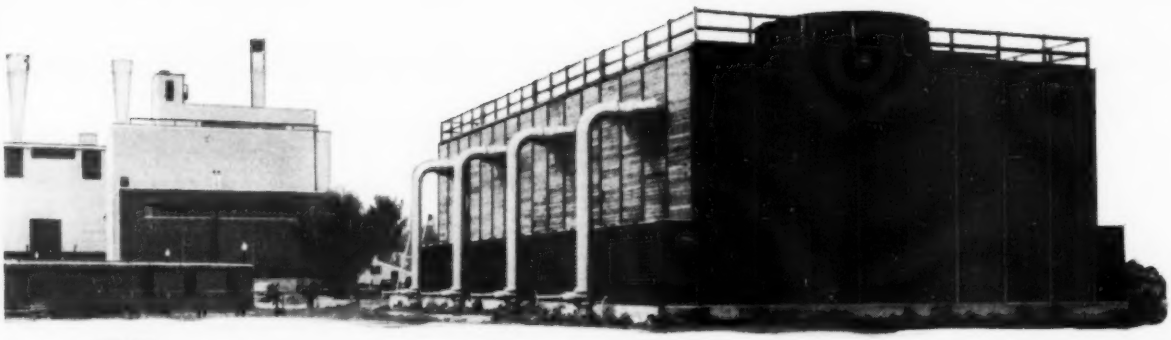

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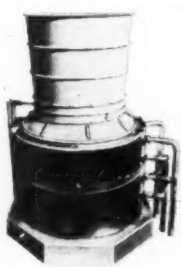

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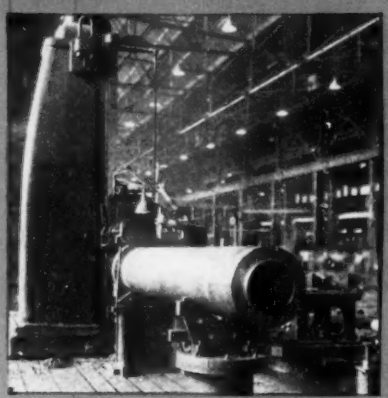

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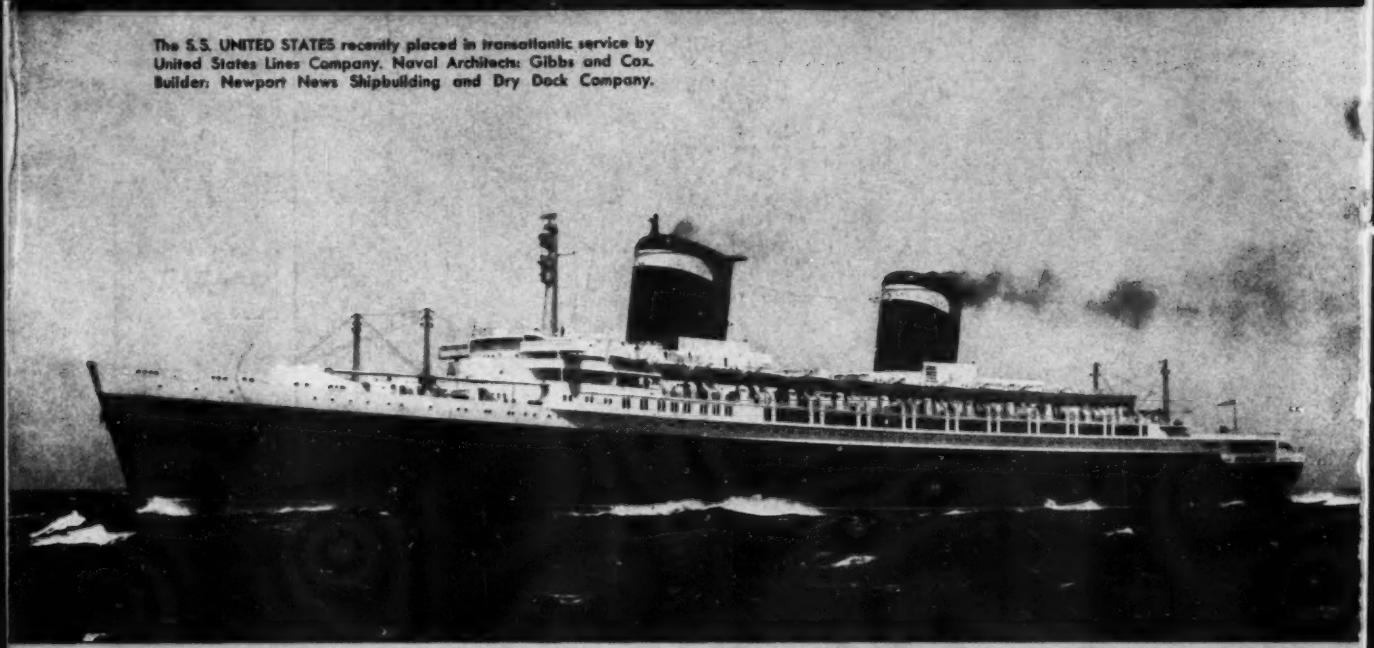

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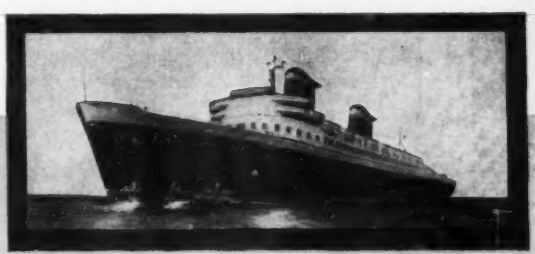

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